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RELATIVE AREAL ZOOPLANKTON ABUNDANCE OFF THE PACIFIC COAST

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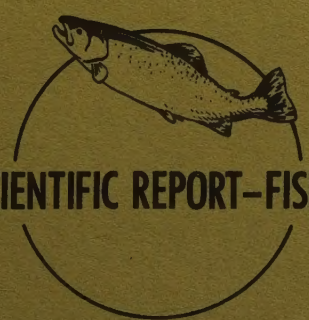


SPECIAL SCIENTIFIC REPORT–FISHERIES No. 188

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

EXPLANATORY NOTE

The series embodies results of investigations, usually of restricted scope, intended to aid or direct management or utilization practices and as guides for administrative or legislative action. it is issued in limited quantities for official use of Federal, State or cooperating agencies and in processed form for economy and to avoid delay in publication.

United States Department of the Interior, Fred A. Seaton, Secretary
Fish and Wildlife Service, John L. Farley, Director

RELATIVE AREAL ZOOPLANKTON ABUNDANCE OFF THE PACIFIC COAST

by

James R. Thrailkill
Fishery Research Biologist

Special Scientific Report--Fisheries No. 188

Washington, D. C.

November 1956

RELATIVE AREAL ZOOPLANKTON ABUNDANCE OFF THE PACIFIC COAST

Zooplankton volumes for the period 1949-1955 have been reported in a series of six Special Scientific Reports--Fisheries, which are listed at the end of the text of this report. Also included in this report are monthly and yearly distribution charts contouring the plankton volumes found in the area surveyed on cruises of the California Cooperative Oceanic Fisheries Investigations. These charts graphically present the data contained in the previous reports.

The volumes of plankton shown in the charts are "wet" volumes of the smaller organisms. In the reports on plankton volumes, two volumes are given for each station: (1) the total wet volumes standardized to the amount in 1,000 cubic meters (c.m.) of water strained, and (2) the volume of smaller organisms after the removal of larger organisms, such as jellies, fish, larger molluscs, larger crustaceans, squid, pyrosomes, and salps. Our criterion of a larger organism (except in the case of juvenile or adult fish) is one whose volume exceeds 5 cc.

In determining the volume of a sample, the plankton was separated from its preserving liquid by filtering and was allowed to drain. Then, the volume of plankton was determined by the displacement process.

In the accompanying charts, the abundance of plankton has been divided into five categories, as follows: (1) light, 0 to 33 cc. of plankton per 1,000 cubic meters of water strained; (2) moderate, 34 to 100 cc. of plankton per 1,000 cubic meters of water strained; (3) average, 101 to 300 cc. of plankton per 1,000 cubic meters of water strained; (4) fairly heavy, 301 to 900 cc. of plankton per 1,000 cubic meters of water strained; and (5) heavy, more than 900 cc. of plankton per 1,000 cubic meters of water strained. These categories have been chosen in order to obtain good contrast between light and heavy concentrations of plankton. Other numerical groupings were tried, such as multiples of 10, but they were found to be less satisfactory than the categories employed.

Throughout the period covered by the charts, the same type of plankton net was used. This type of net is constructed of No. 30xxx grit gauze (an extra heavy type of silk bolting cloth) and is 1 meter wide at the mouth and about 5 meters long. The anterior section of the net, approximately 1 meter wide, is cylindrical, and the posterior section is conical. The last 40 centimeters of the cod-end bag is made of No. 56xxx silk grit gauze.

The depth of haul has not been uniform throughout the period covered by the charts. In 1949 and 1950, hauls were taken to depths of about 70 meters (100 meters of towing wire were payed out); since 1951, the hauls have been made to depths of about 140 meters (200 meters of towing wire were payed out). On the average, the upper 70 meters is richer in plankton than the zone from 70 to 140 meters. Based on information obtained from closing hauls (1940 survey off southern California), the average plankton volume in the 70 to 140 meter zone is about 60 percent as great as that of the upper level. If a similar relationship held over the entire California Cooperative Oceanic Fisheries Investigations area, the standardized volumes in 1949 and 1950, based on 0 to 70 meter oblique hauls, would average 25 percent larger than the volumes based on deeper hauls.

In both instances, plankton volumes have been standardized to the amount in 1,000 cubic meters of water strained. The procedure for determining the volume of water strained during each plankton haul is discussed in Special Scientific Report--Fisheries No. 136, p. 2, and will not be repeated here.

The system of numbering cruises was changed in 1953, in order to identify cruises more readily. Originally, cruises were numbered consecutively, No. 1 being the March cruise of 1949. Under the new system of numbering, each cruise is designated by four digits -- the first two numerals refer to the year, and the next two numerals refer to the month. Thus, cruise 4903 refers to the March cruise of 1949; and cruise 5112 is the December cruise of 1951.

Table 1 presents a chronological listing of California Cooperative Oceanic Fisheries Investigations cruises through 1955, with information on the area covered and the number of stations occupied on each cruise. It will be noted that the station line designations for 1949 are different than those used subsequently. The equivalents of the 1949 stations in the current numbering system have been given in "Station Positions of the California Cooperative Sardine Research Program", 1952, S10 reference 52-64, prepared by the Scripps Institution of Oceanography and the Fish and Wildlife Service. They are also given in "Zooplankton Volumes off the Pacific Coast, 1949-1950", Special Scientific Report--Fisheries No. 125, p.3.

Since 1950, the same method of numbering stations has been followed, although the number of stations occupied per cruise has been changed with season and time. The intensity of coverage has gradually increased from year to year, especially during the months of heavy spawning of the Pacific sardine (March through June).

Table 1.--Chronological list of cruises of the California Cooperative Oceanic Fisheries Investigations, March 1949 to December 1955.

Date of cruise	Cruise No. Present numbering system	Cruise No. Original numbering system	Station lines occupied	Number of stations occupied
March 1949	4903	1	5 to 12	69
April 1949	4904	2	3 to 12	92
May 1949	4905	3	1 to 12	106
June 1949	4906	4	4 to 12	80
July 1949	4907	5	1 to 12	110
August 1949	4908	6	1 to 12	118
Sept. 1949	4909	7	2 to 12	113
Oct. 1949	4910	8	1 to 12	104
Nov. 1949	4911	9	1 to 12	112
Feb. 1950	5002	11	50 to 130	112
March 1950	5003	12	40 to 130	101
April 1950	5004	13	40 to 130	118
May 1950	5005	14	40 to 130	124
June 1950	5006	15	40 to 130	107
July 1950	5007	16	40 to 130	140
August 1950	5008	17	20 to 90	93
Sept. 1950	5009	18	30 to 130	107
Nov. 1950	5011	20	83 to 157	95
Jan. 1951	5101	21	60 to 137	125
Feb. 1951	5102	22	80 to 137	98
March 1951	5103	23	80 to 157	137
April 1951	5104	24	60 to 137	138
May 1951	5105	25	60 to 137	128
June 1951	5106	26	60 to 157	169
July 1951	5107	27	40 to 137	104
August 1951	5108	28	40 to 137	128
Sept. 1951	5109	29	60 to 157	134
Oct. 1951	5110	30	60 to 137	116
Nov. 1951	5111	31	60 to 137	89
Dec. 1951	5112	32	63 to 123	65
Jan. 1952	5201	33	80 to 137	94
Feb. 1952	5202	34	80 to 150	109
March 1952	5203	35	80 to 137	91+ 63
April 1952	5204	36	60 to 137	158
May 1952	5205	37	60 to 137	186
June 1952	5206	38	50 to 137	193
July 1952	5207	39	40 to 137	179
August 1952	5208	40	60 to 137	86
Sept. 1952	5209	41	60 to 137	94
Oct. 1952	5210	42	60 to 137	88

Nov. 1952	5211	43	60 to 137	91
Jan. 1953	5301	---	80 to 150	95
Feb. 1953	5302	---	80 to 137	96
March 1953	5303	---	80 to 137	112 + 63
April 1953	5304	---	60 to 137	190
May 1953	5305	---	60 to 137	185
June 1953	5306	---	60 to 137	196
July 1953	5307	---	60 to 137	122
August 1953	5308	---	60 to 137	118
Sept. 1953	5309	---	83 to 87, 113 to 120	40
Oct. 1953	5310	---	83 to 137	69
Nov. 1953	5311	---	83 to 87	19
Dec. 1953	5312	---	83 to 137	82
Jan. 1954	5401	---	77 to 150	134
Feb. 1954	5402	---	77 to 137	116
March 1954	5403	---	77 to 137	153
April 1954	5404	---	60 to 137	196
May 1954	5405	---	60 to 137	205
June 1954	5406	---	50 to 137	209
July 1954	5407	---	60 to 137	118
August 1954	5408	---	60 to 137	122
Oct. 1954	5410	---	77 to 137	105
Dec. 1954	5412	---	80 to 157	115
Jan. 1955	5501	---	80 to 157	112
Feb. 1955	5502	---	80 to 157	117
March 1955	5503	---	80 to 157	142
April 1955	5504	---	80 to 137	125
May 1955	5505	---	63 to 137	183
June 1955	5506	---	60 to 137	189
July 1955	5507	---	63 to 137	196
August 1955	5508	---	NORPAC	Not included
Oct. 1955	5510	---	60 to 137	108
Dec. 1955	5512	---	80 to 137	106

These investigations are part of the California Cooperative Oceanic Fisheries Investigations, a program sponsored by the Marine Research Committee, and carried out by the Scripps Institution of Oceanography of the University of California, the Bureau of Marine Fisheries of the California Department of Fish and Game, the Hopkins Marine Station of Stanford University, the California Academy of Sciences and the South Pacific Fishery Investigations of the U. S. Fish and Wildlife Service. Originally, the cooperative program was known as the California Cooperative Sardine Research Program, but the name was changed when the investigations were expanded to include fishes other than the Pacific sardine.

The plankton samples are used in studying the early life histories of fishes, including the distribution and abundance of spawning and the rate of larval survival. Information on distribution and abundance of eggs and/or larvae of six species of fishes: Pacific sardine, northern anchovy, jack mackerel, Pacific mackerel, hake, and rockfish (Sebastodes spp.) are given in a yearly series of reports in Special Scientific Report--Fisheries. These reports parallel those on plankton volumes.

U. S. Fish and Wildlife Service

1952. Zooplankton volumes off the Pacific coast, 1951. U.S. Dept. Interior, Fish and Wildlife Service, Spec. Sci. Rep.--Fisheries No. 73, 37 pp.

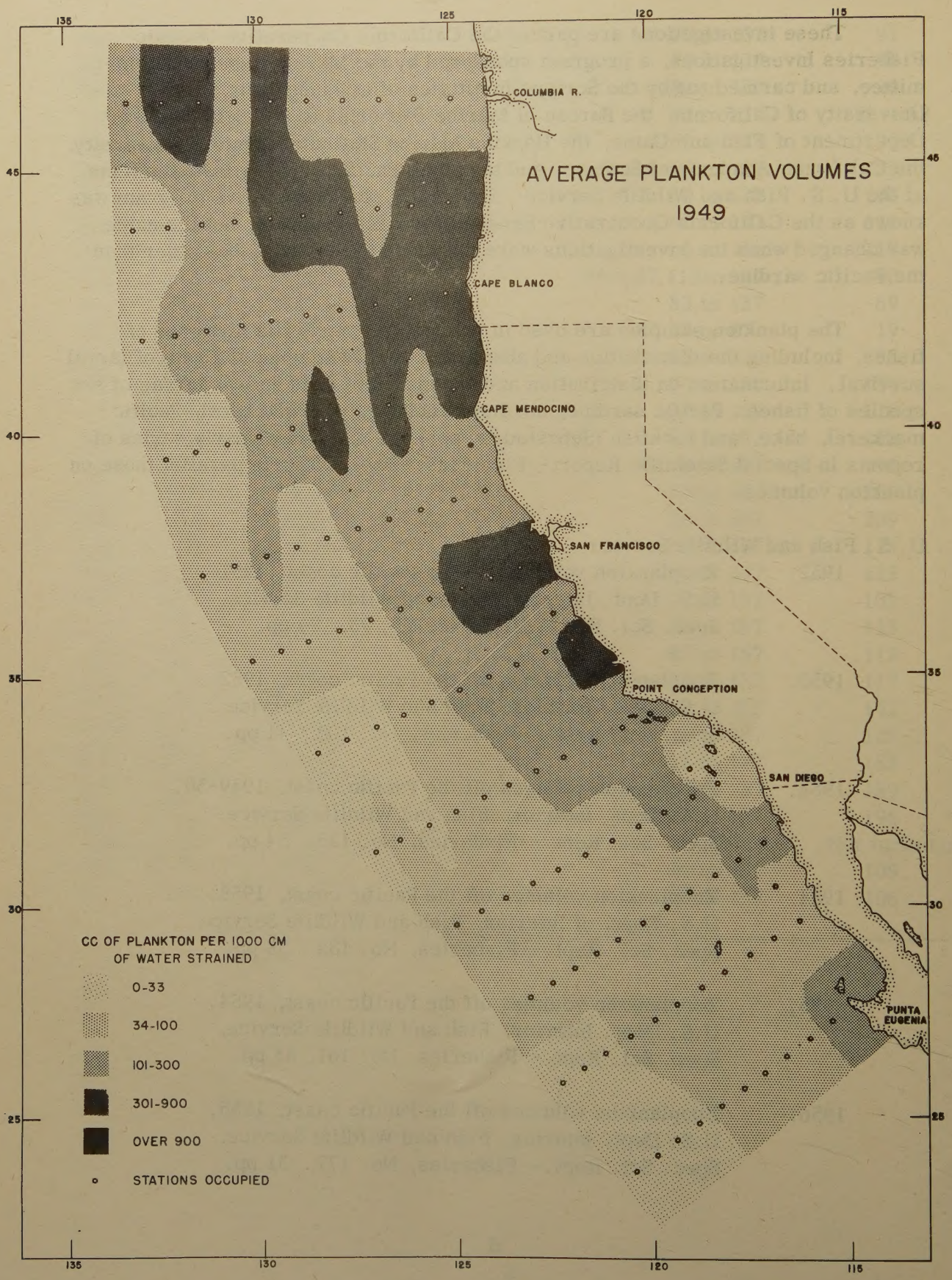
1953. Zooplankton volumes off the Pacific coast, 1952. U.S. Dept. Interior, Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries, No. 100, 41 pp.

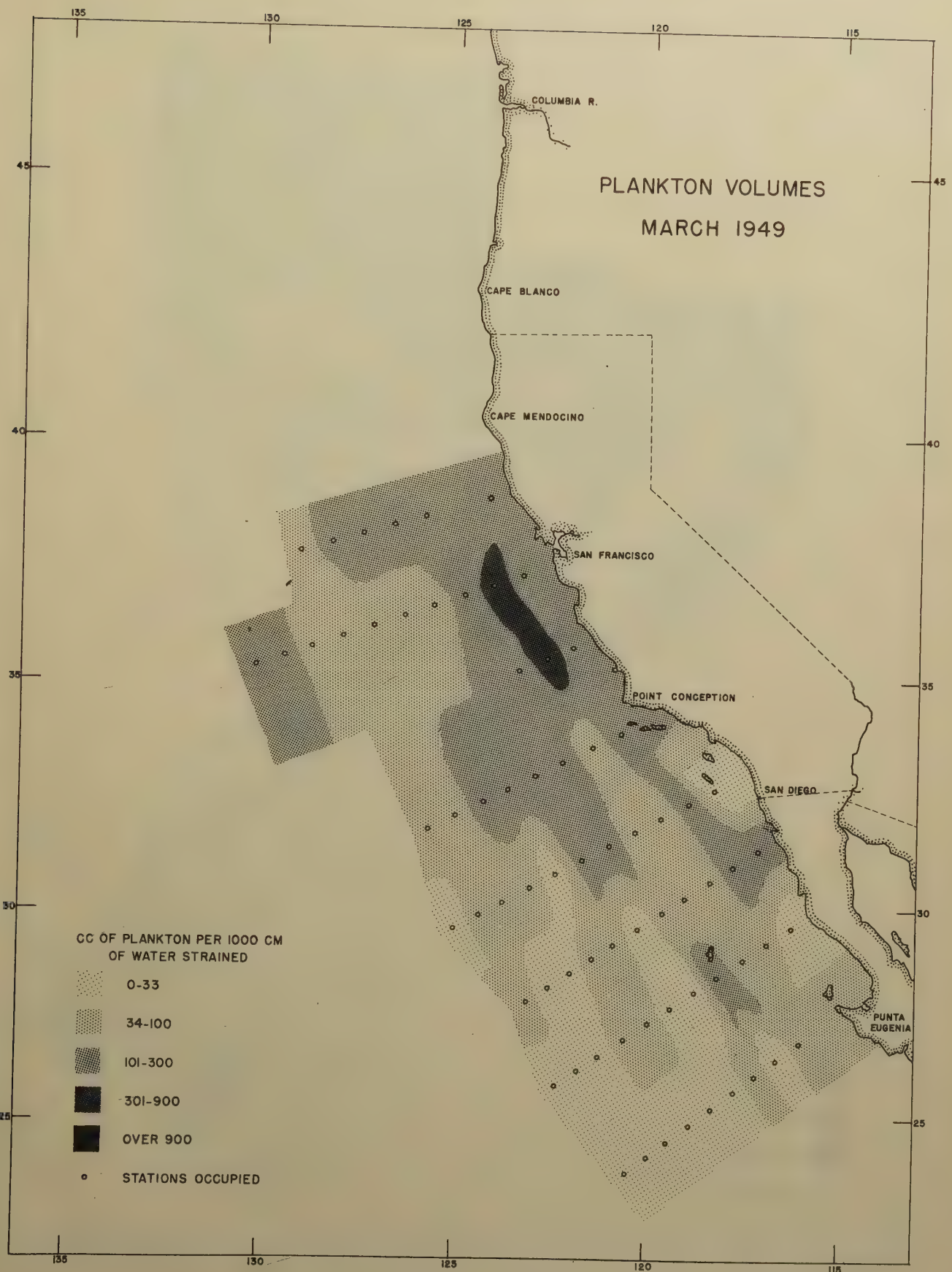
1954. Zooplankton volumes off the Pacific coast, 1949-50. U.S. Dept. Interior, Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries, No. 125, 54 pp.

1954. Zooplankton volumes off the Pacific coast, 1953. U.S. Dept. of Interior, Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries, No. 132, 38 pp.

1955. Zooplankton volumes off the Pacific coast, 1954. U.S. Dept. Interior, Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries, No. 161, 35 pp.

1956. Zooplankton volumes off the Pacific coast, 1955. U.S. Dept. Interior, Fish and Wildlife Service, Spec. Sci. Rept.--Fisheries, No. 177, 31 pp.


AVERAGE PLANKTON VOLUMES
1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
135
130
125
120
115
45
40
35
30
25
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MARCH 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
135
130
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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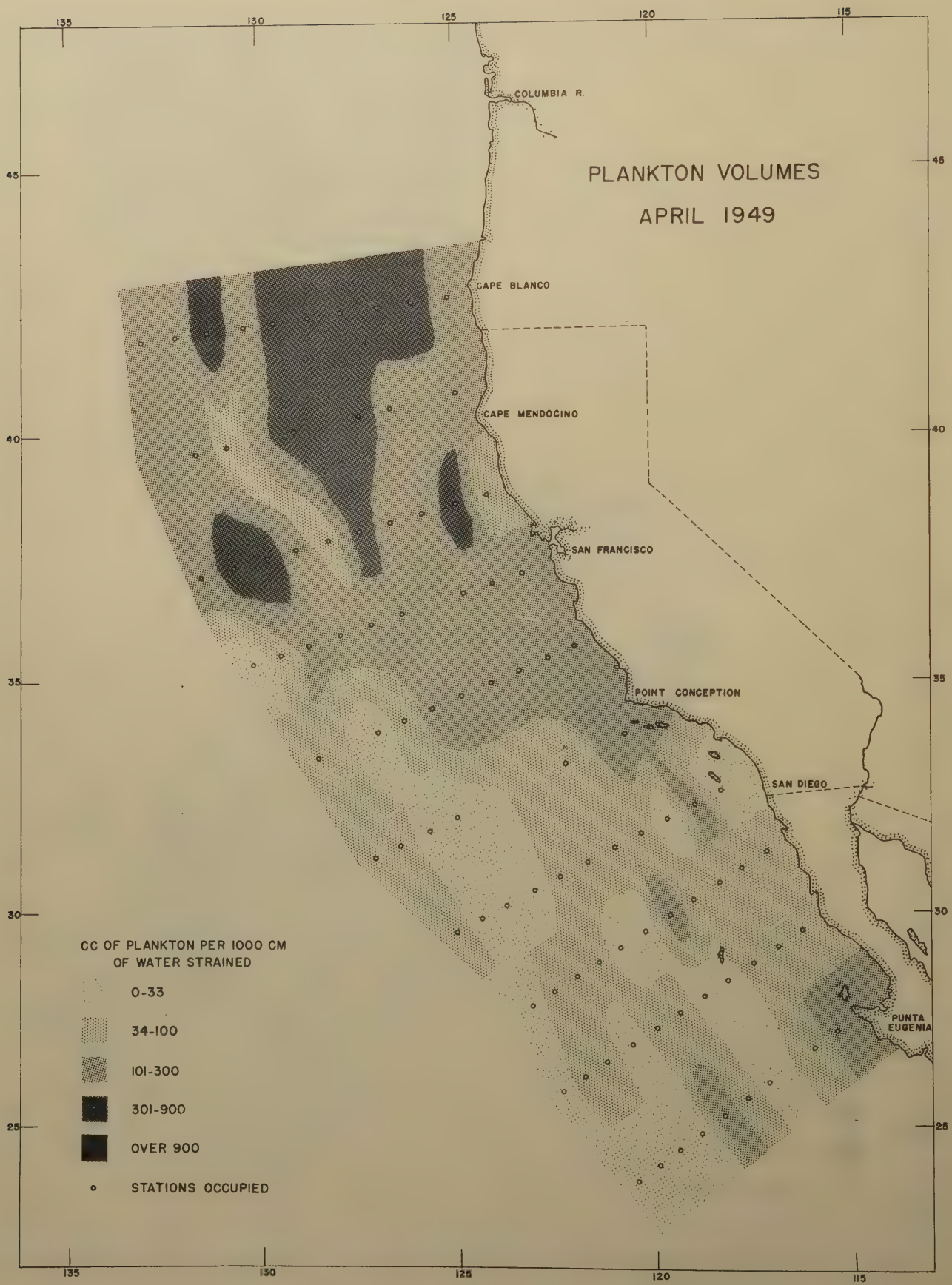
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
APRIL 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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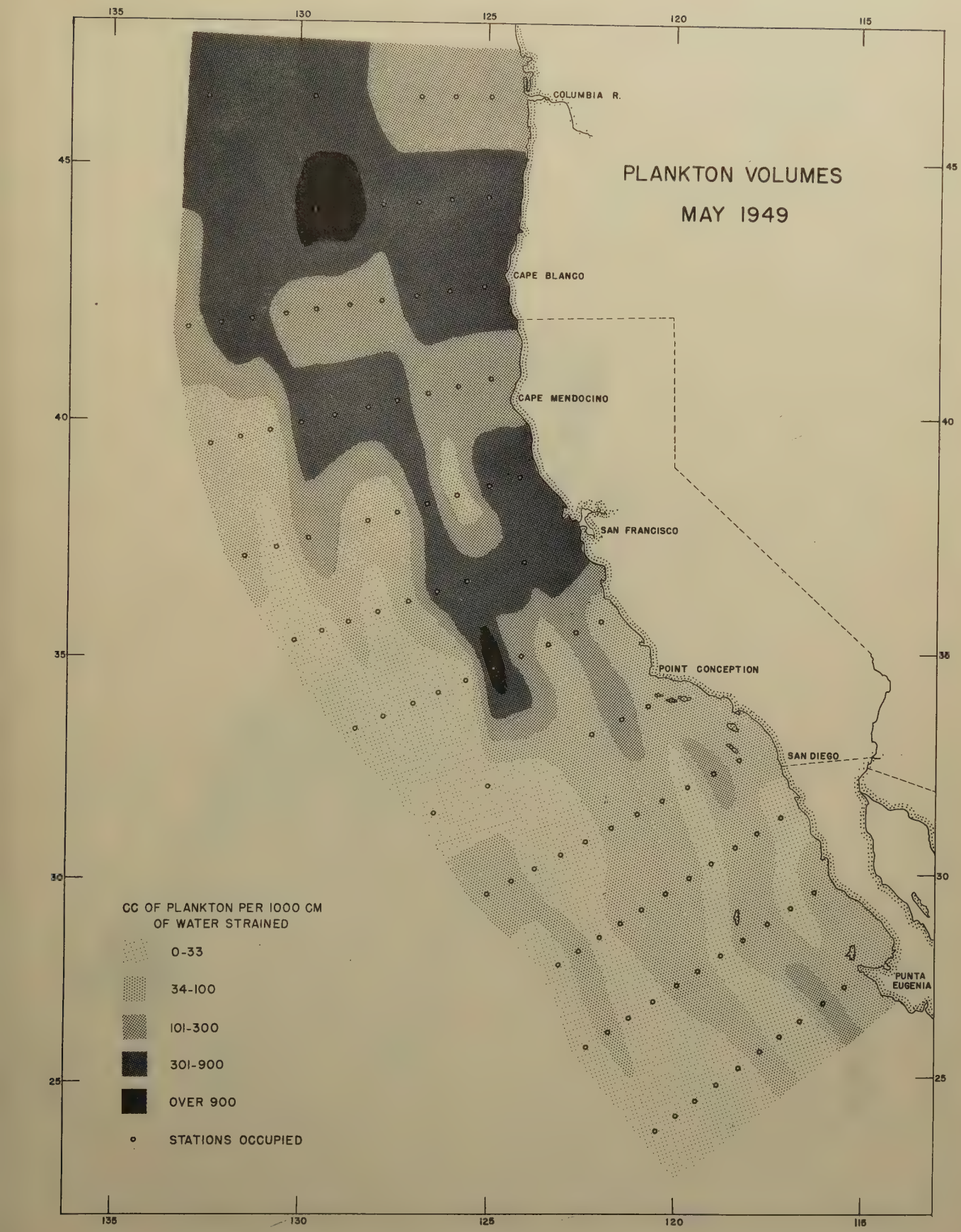
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MAY 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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OVER 900
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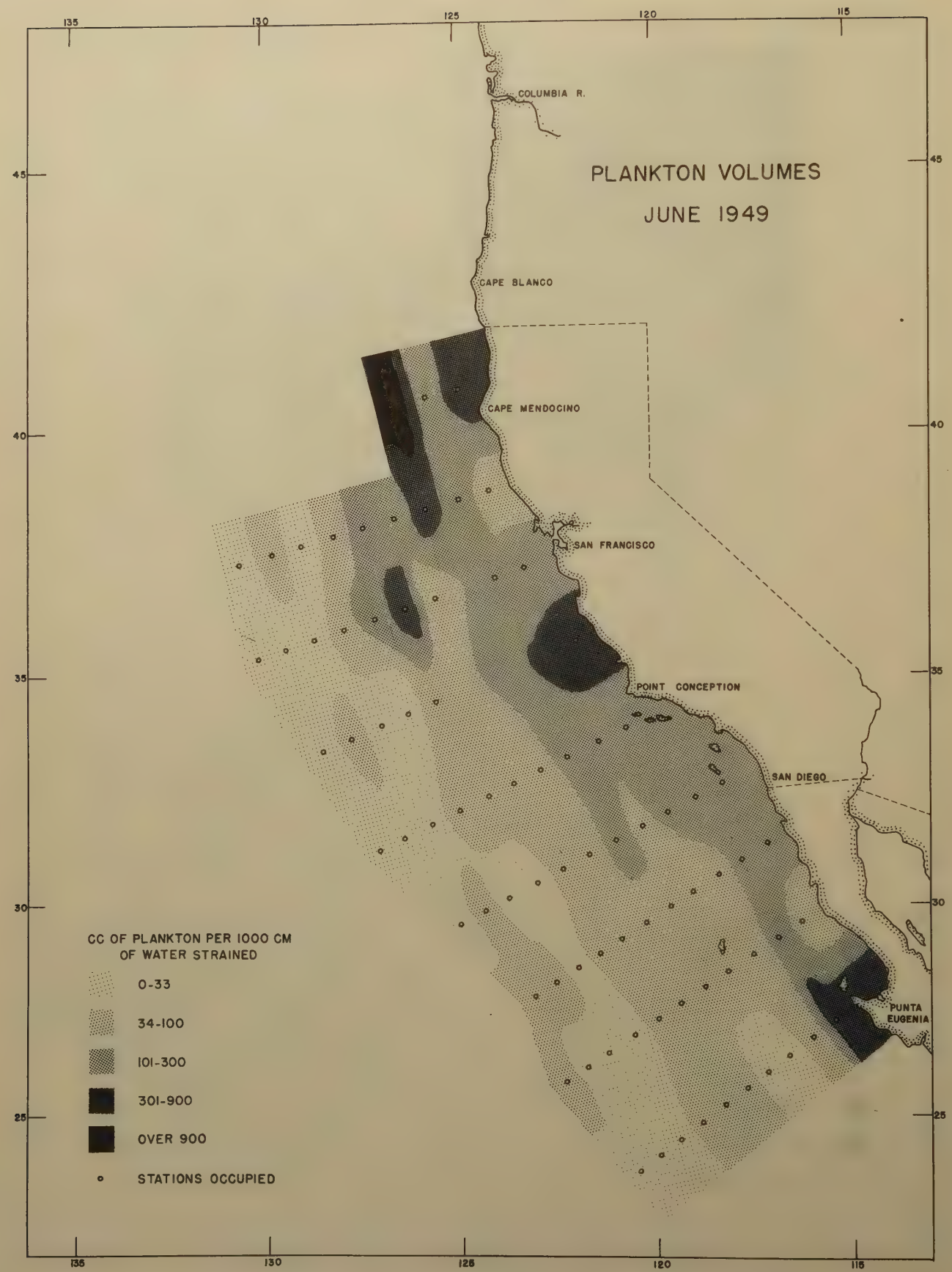
PLANKTON VOLUMES
JUNE 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
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PUNTA EUGENIA
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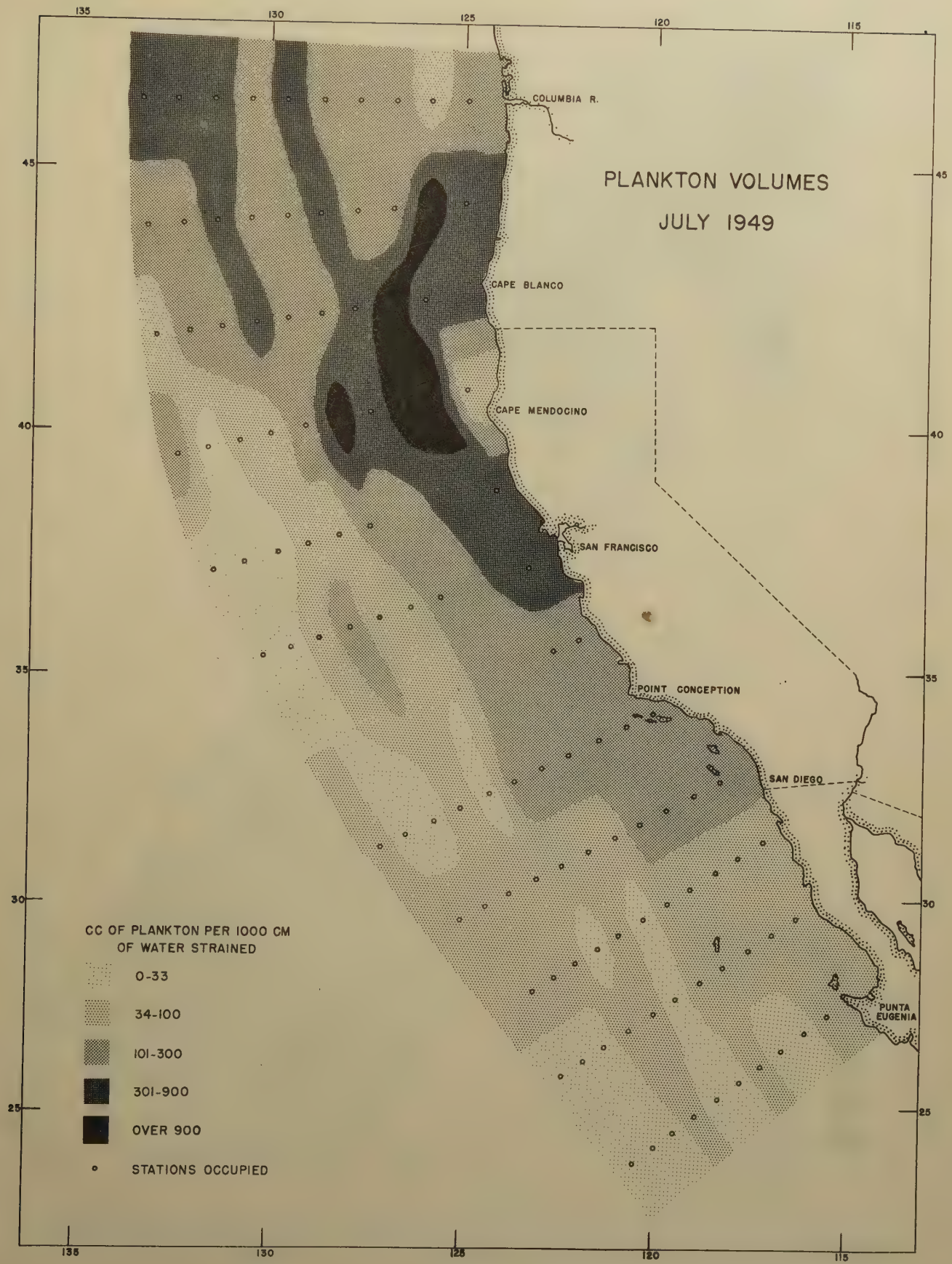
PLANKTON VOLUMES
JULY 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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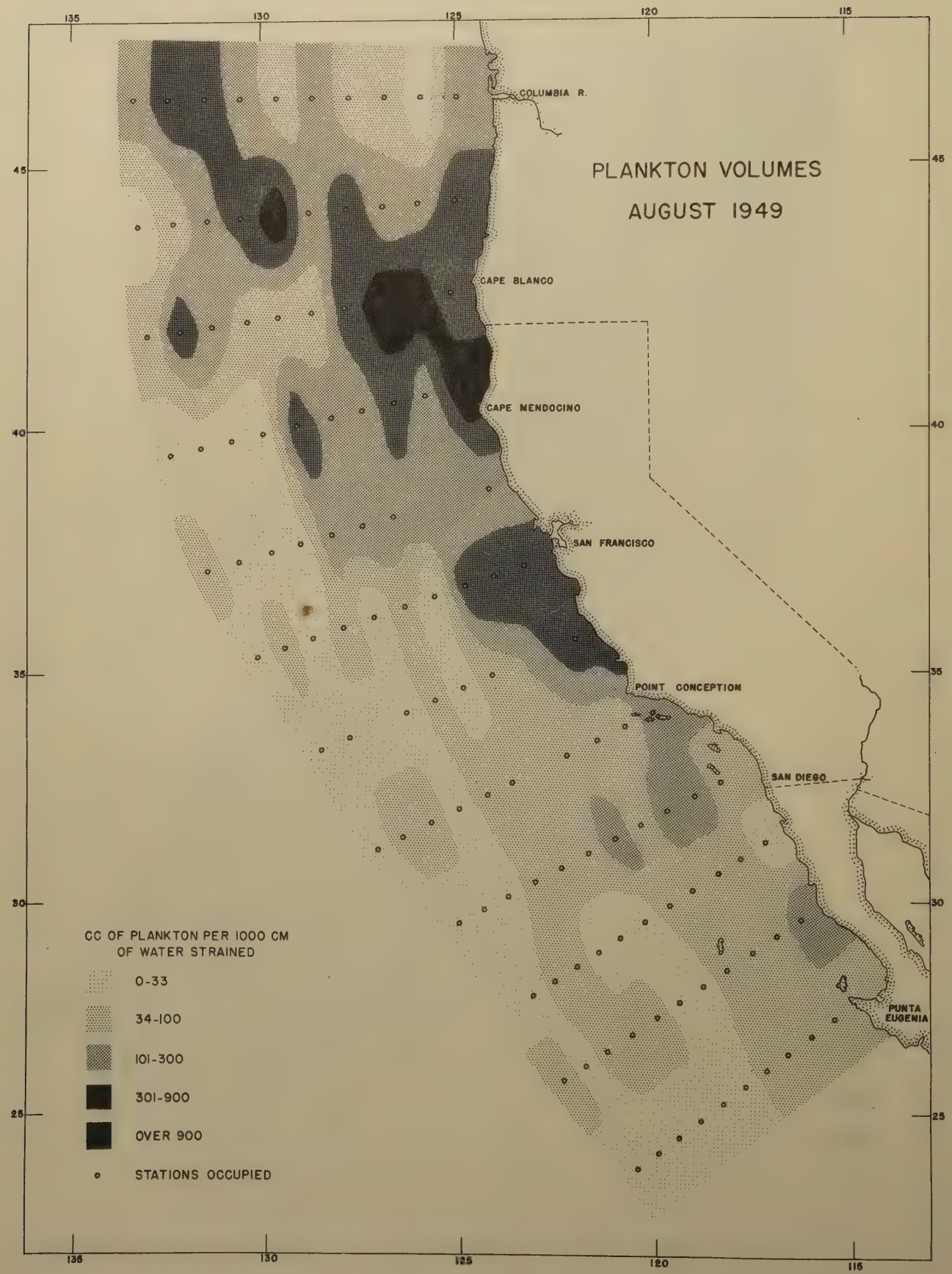
PLANKTON VOLUMES
AUGUST 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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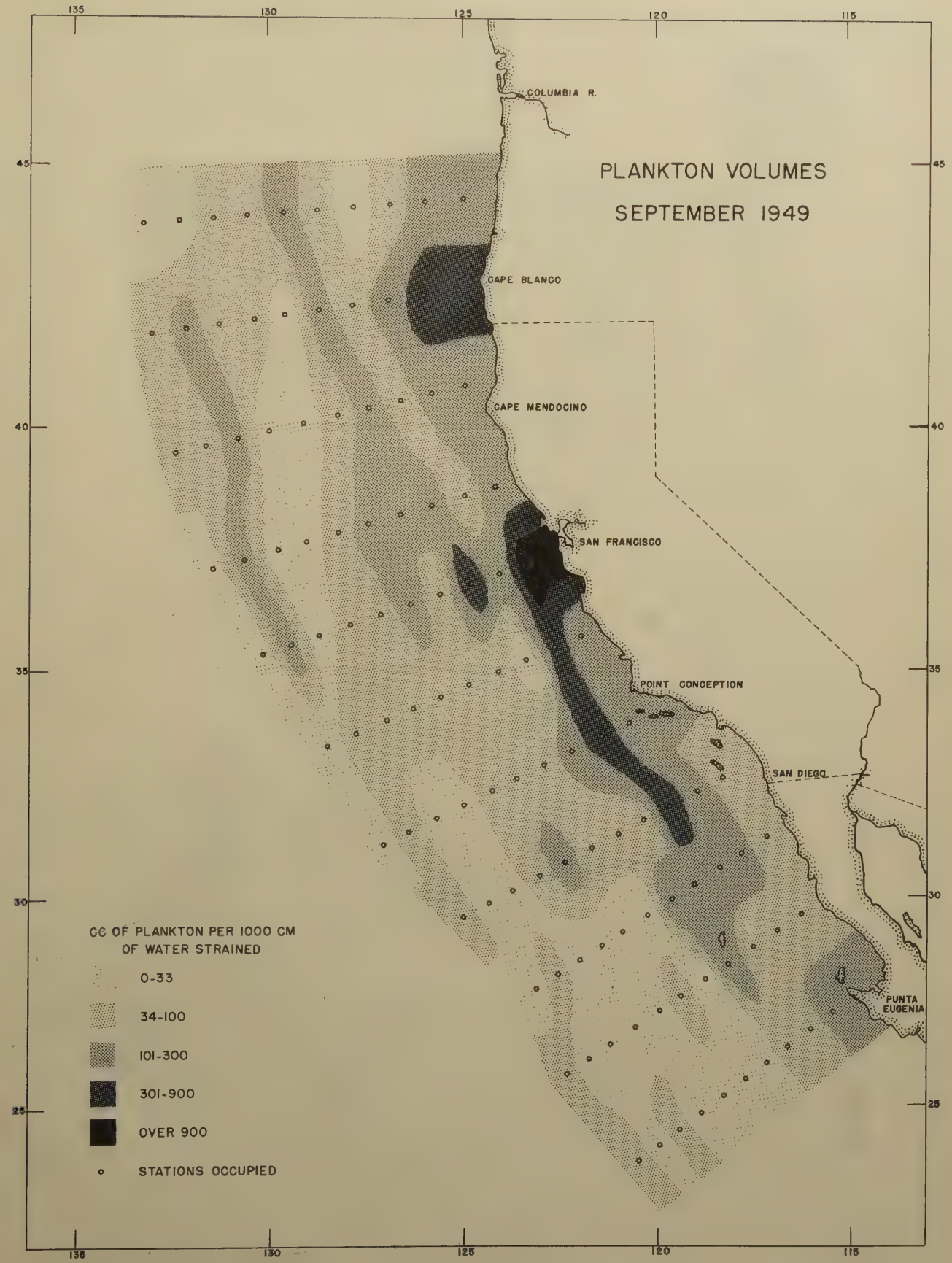
PLANKTON VOLUMES
SEPTEMBER 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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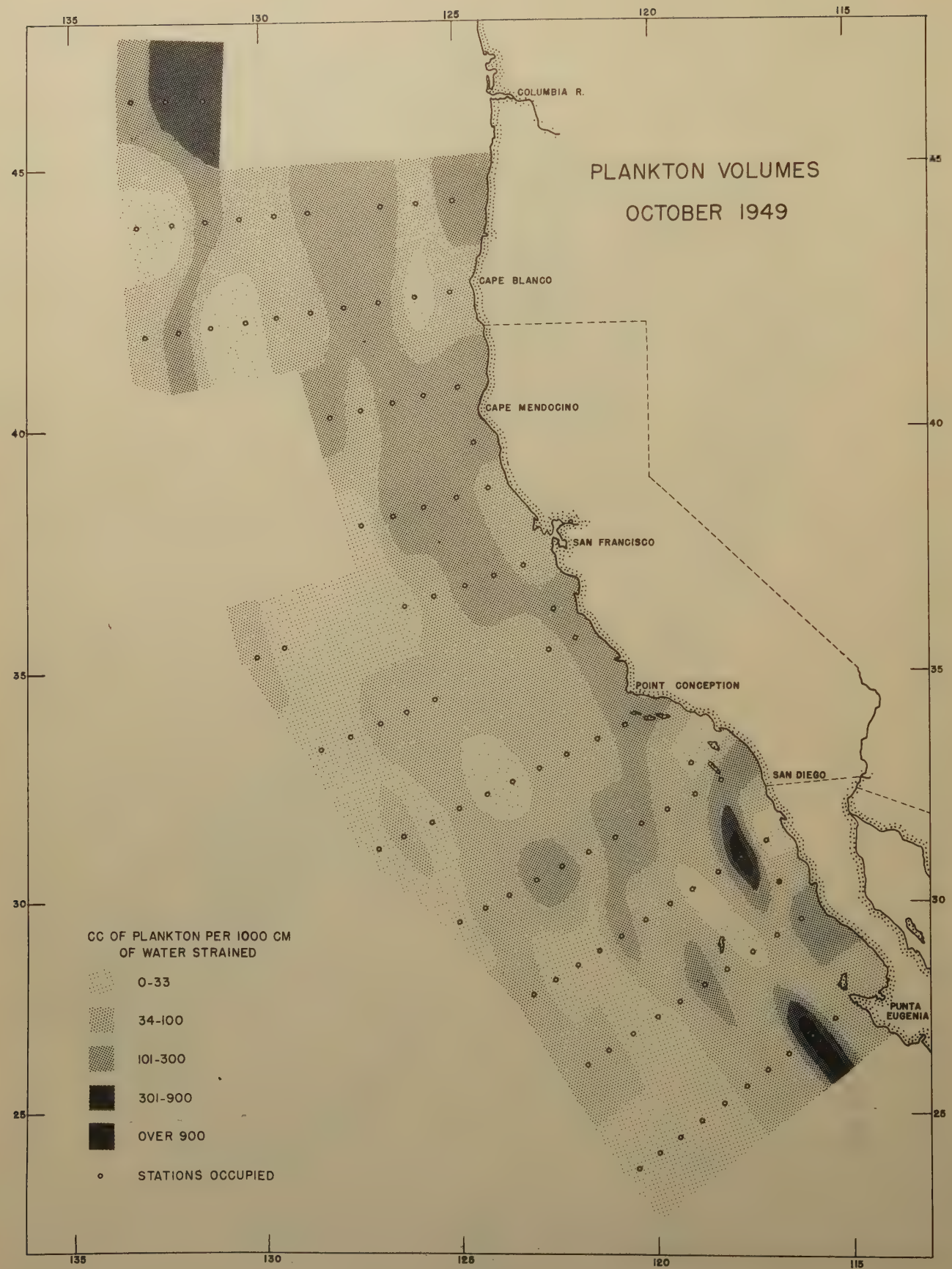
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
OCTOBER 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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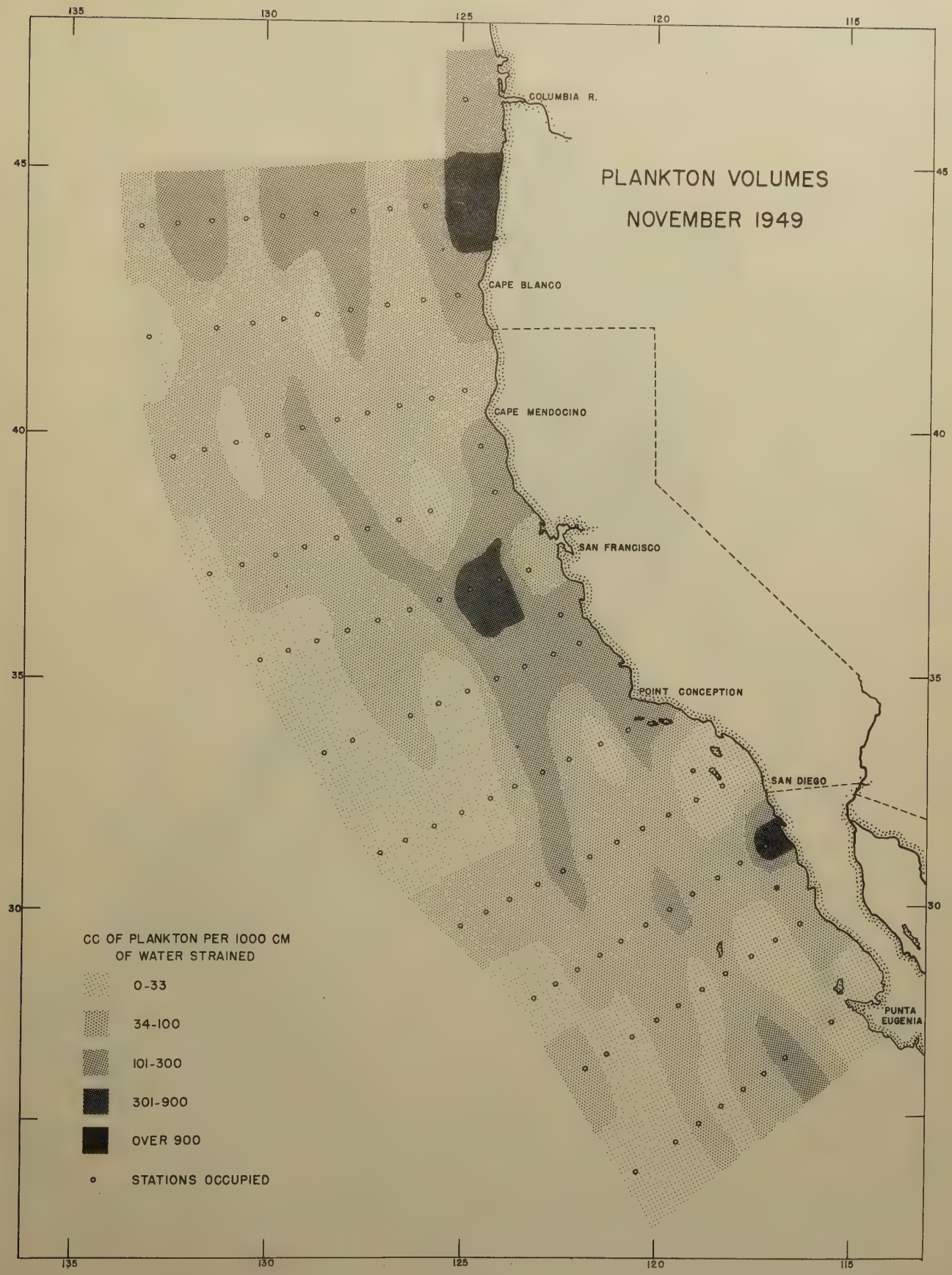
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
NOVEMBER 1949
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
135
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
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OVER 900
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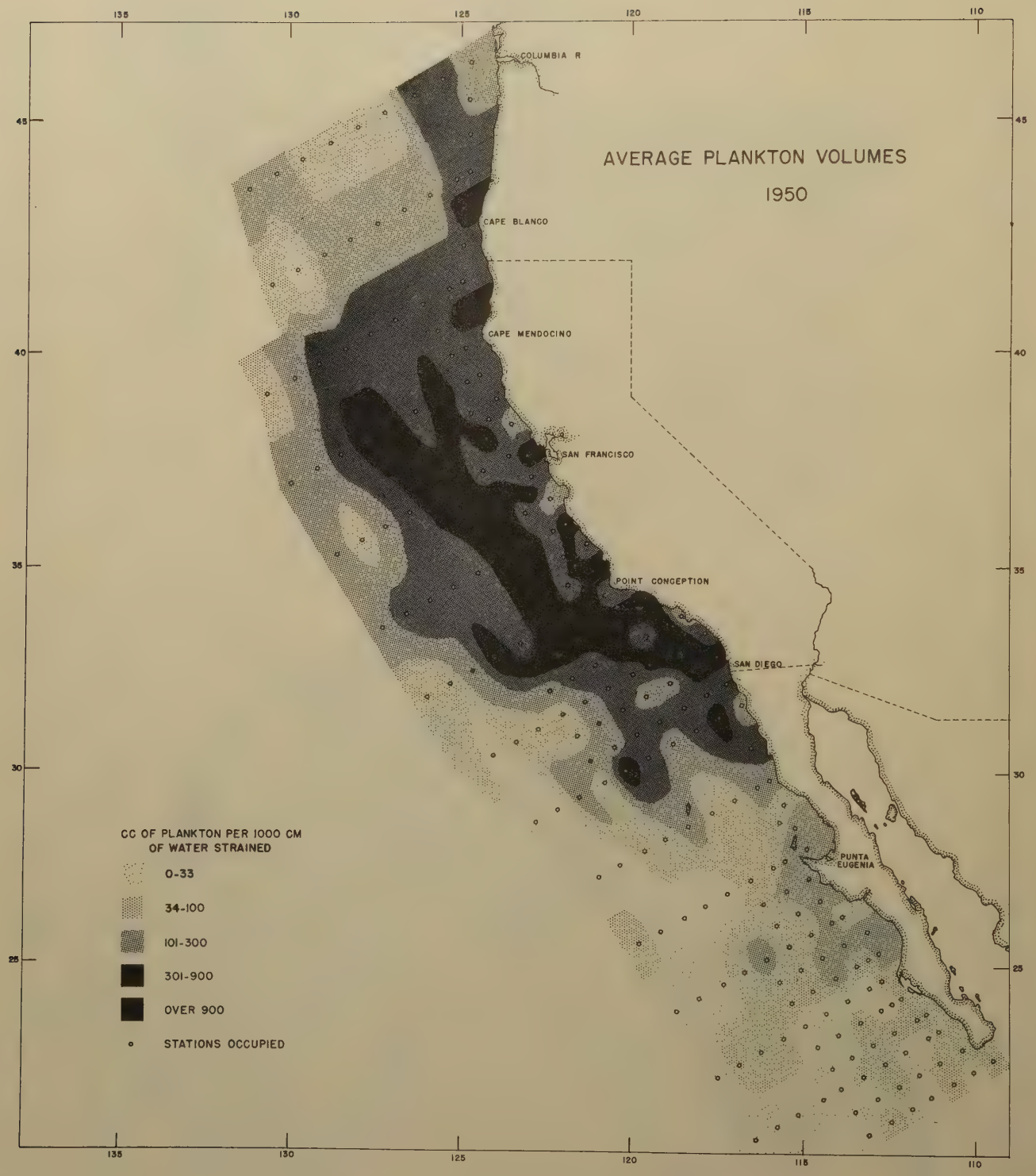
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1950
COLUMBIA R
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED
135
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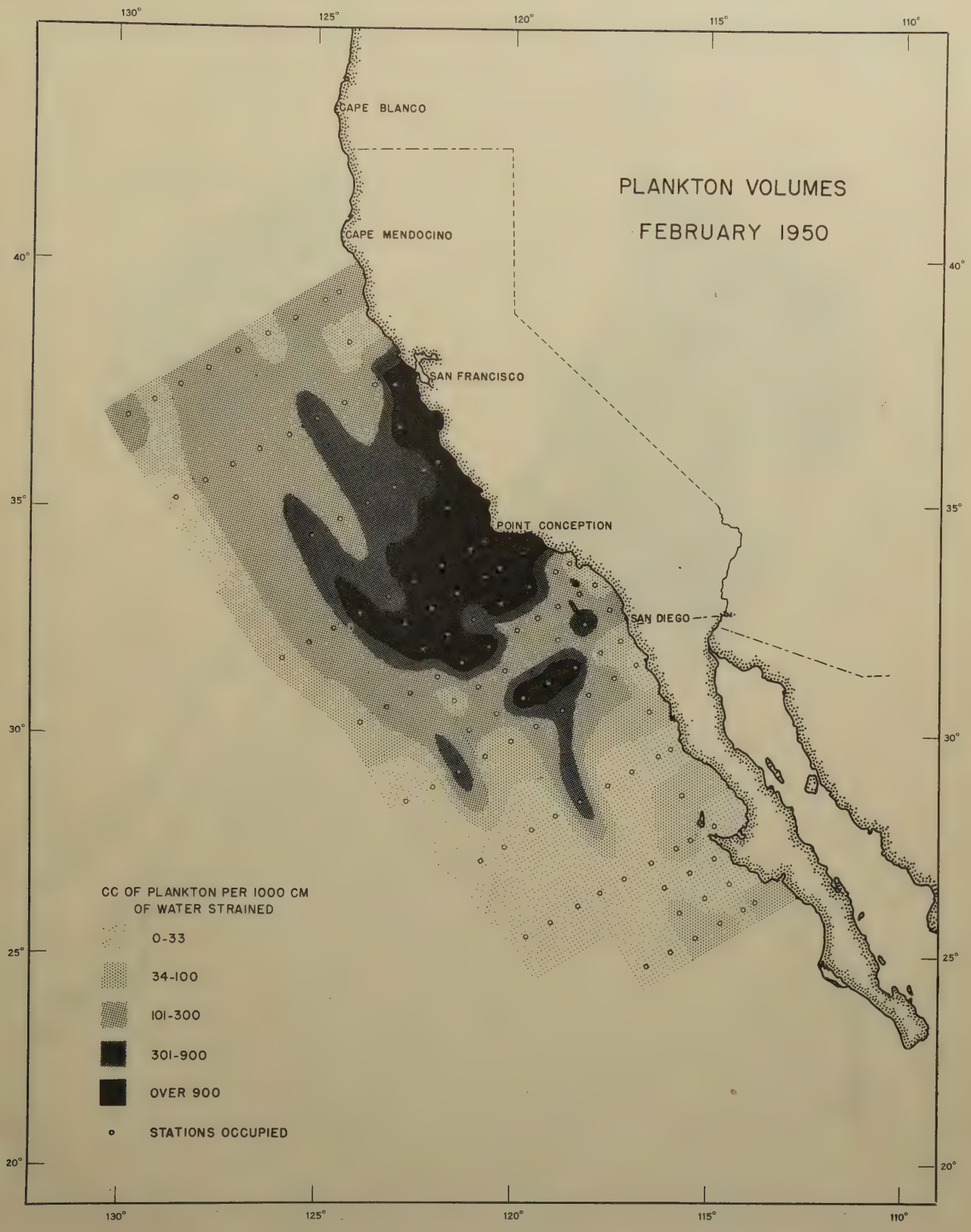
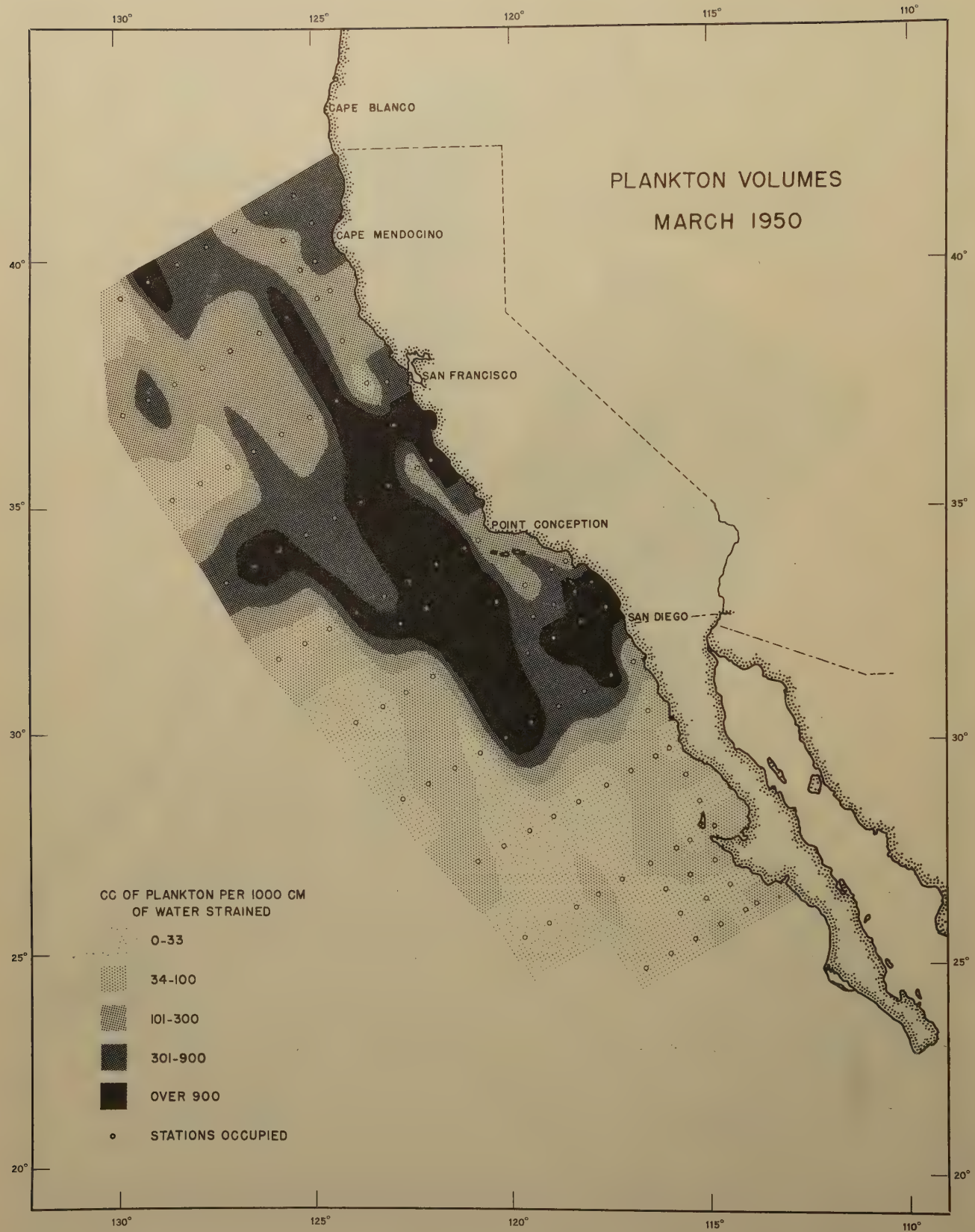

PLANKTON VOLUMES
FEBRUARY 1950
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MARCH 1950
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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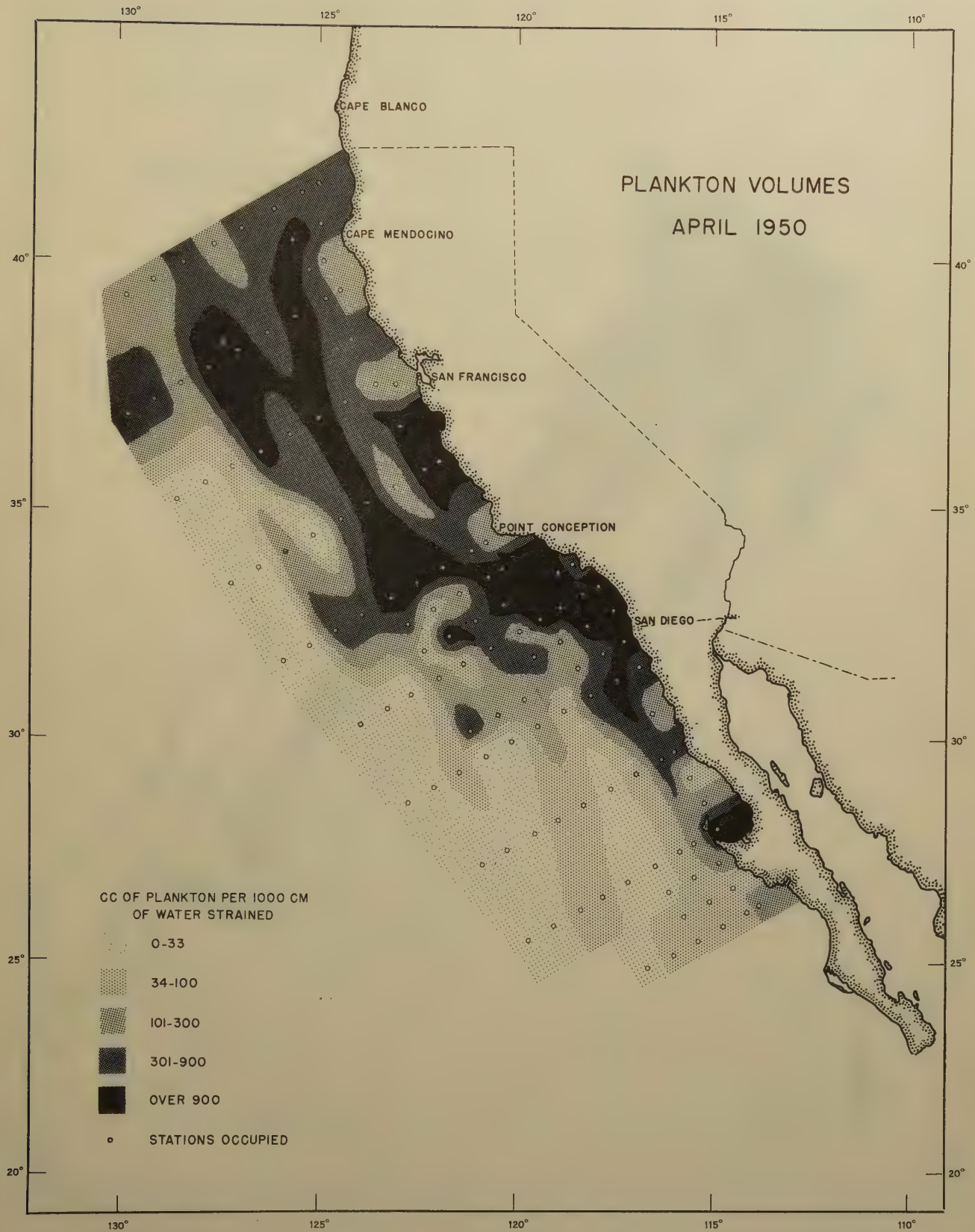
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
APRIL 1950
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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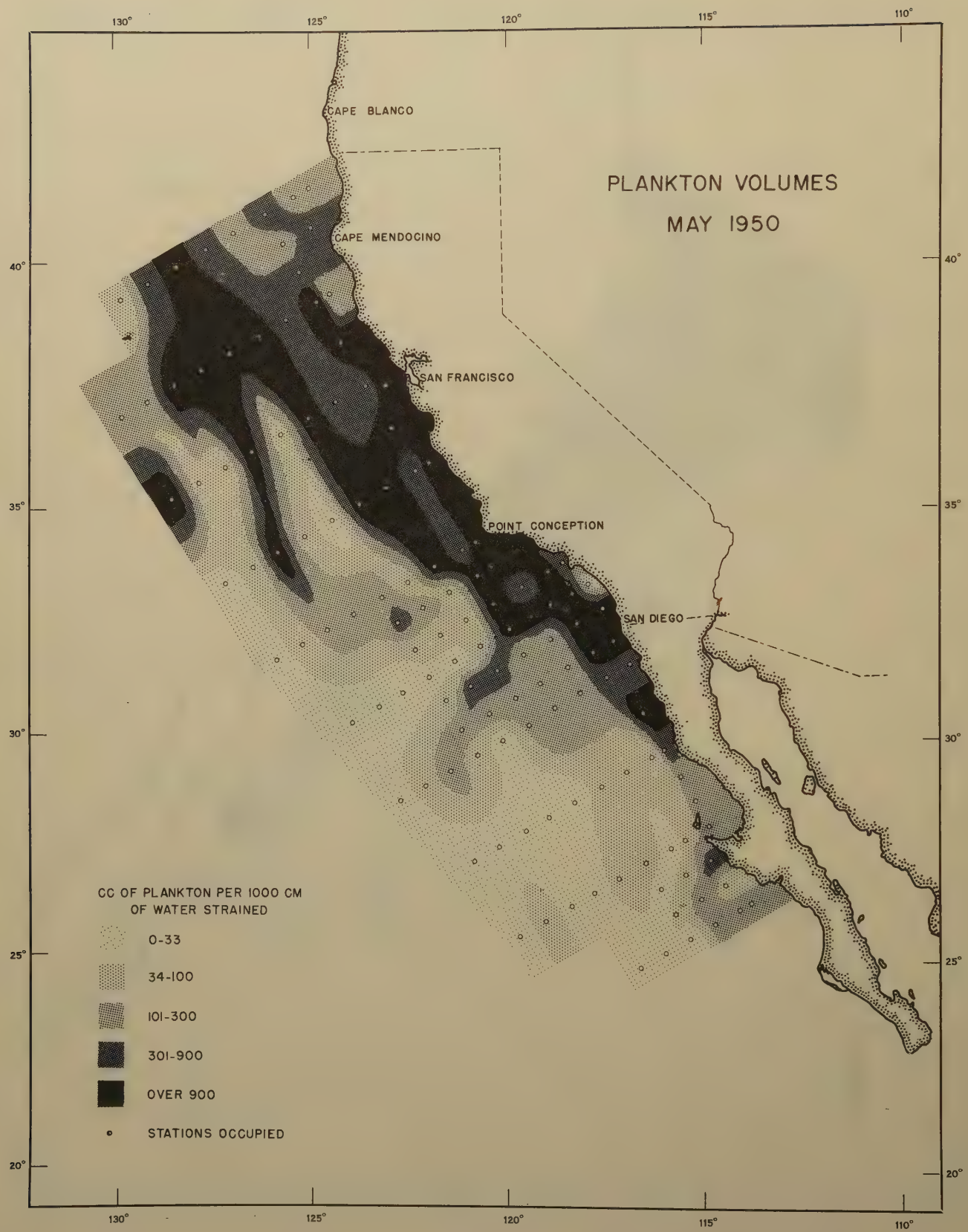
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MAY 1950
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
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CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
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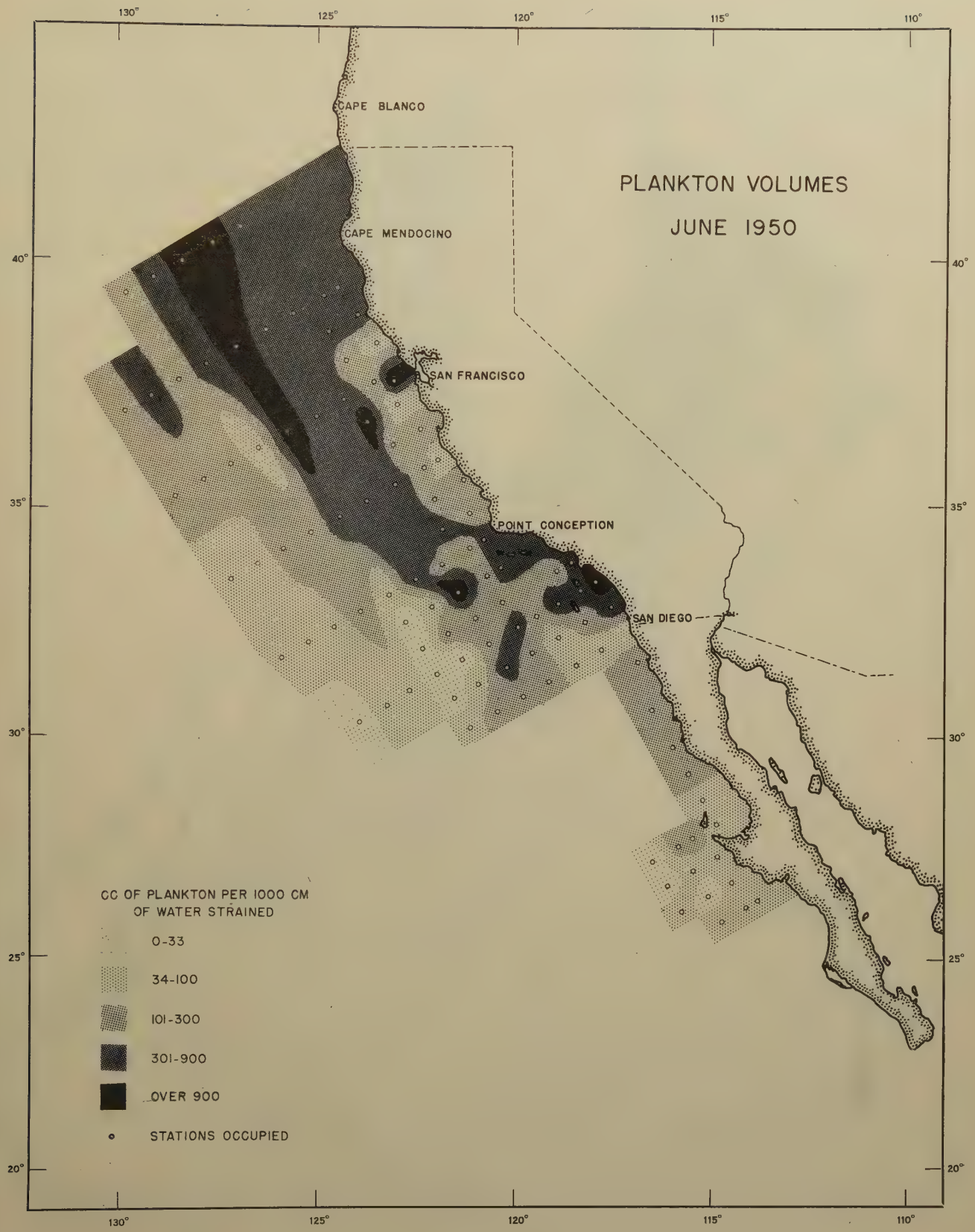
STATIONS OCCUPIED


PLANKTON VOLUMES
JUNE 1950
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
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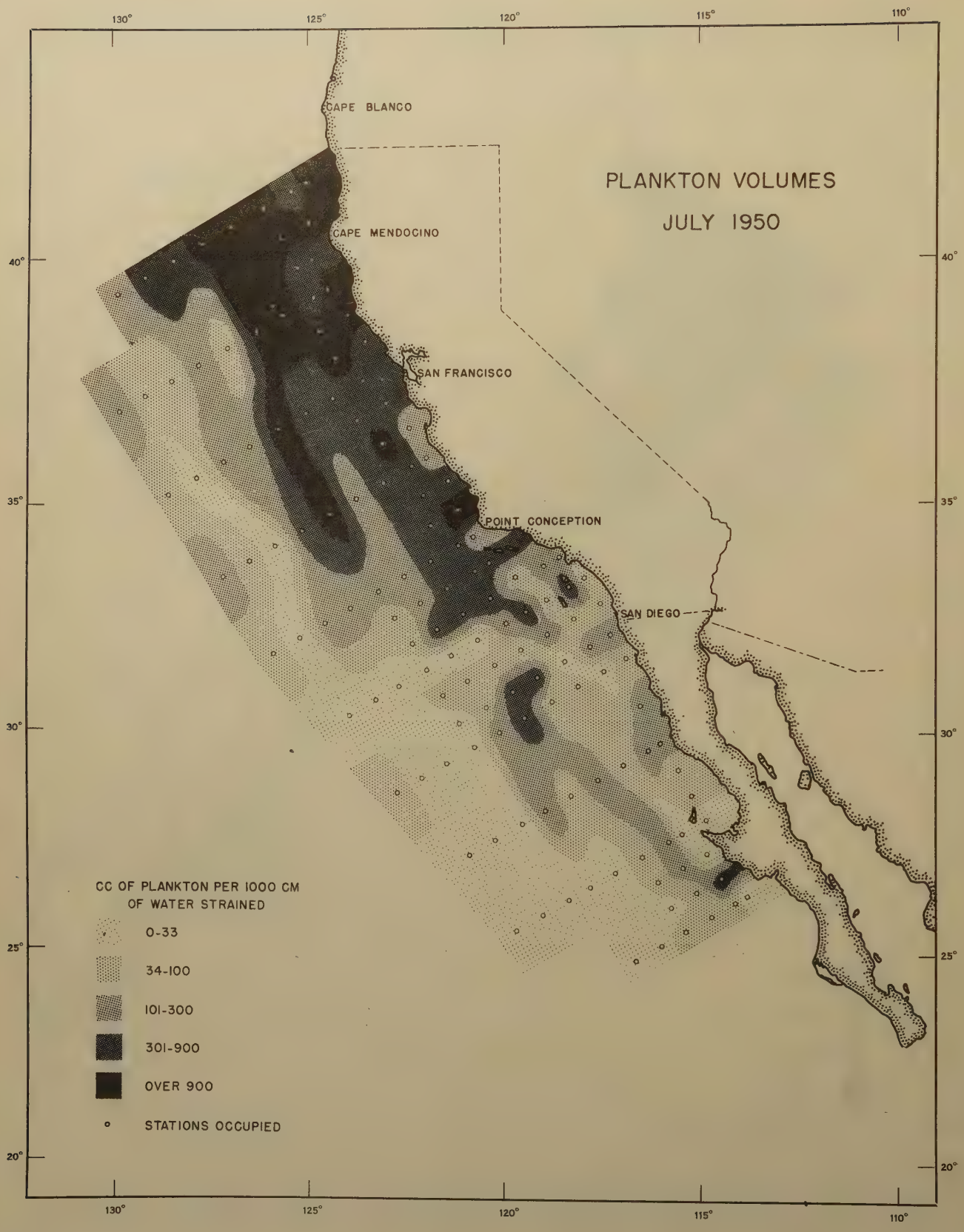
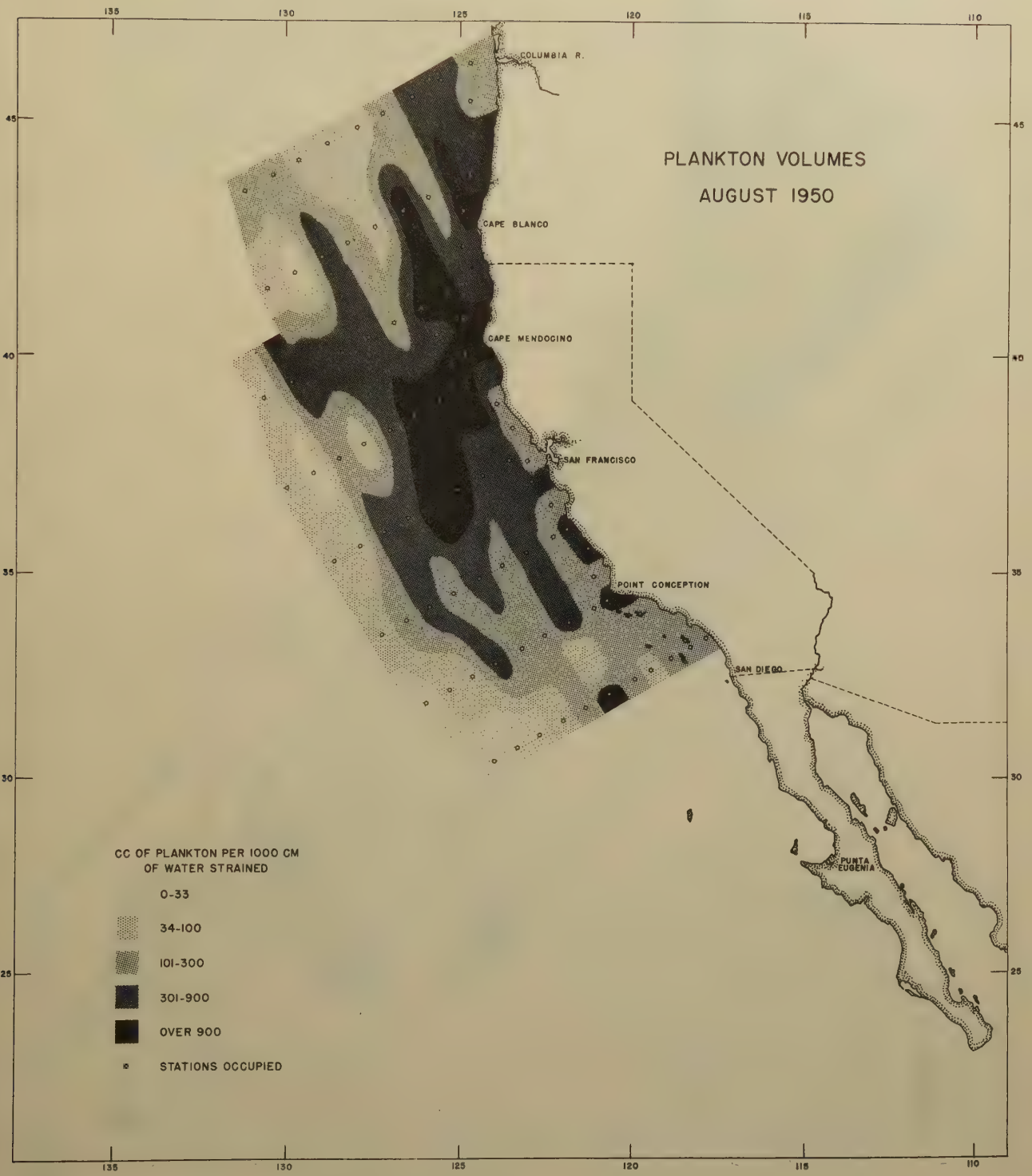
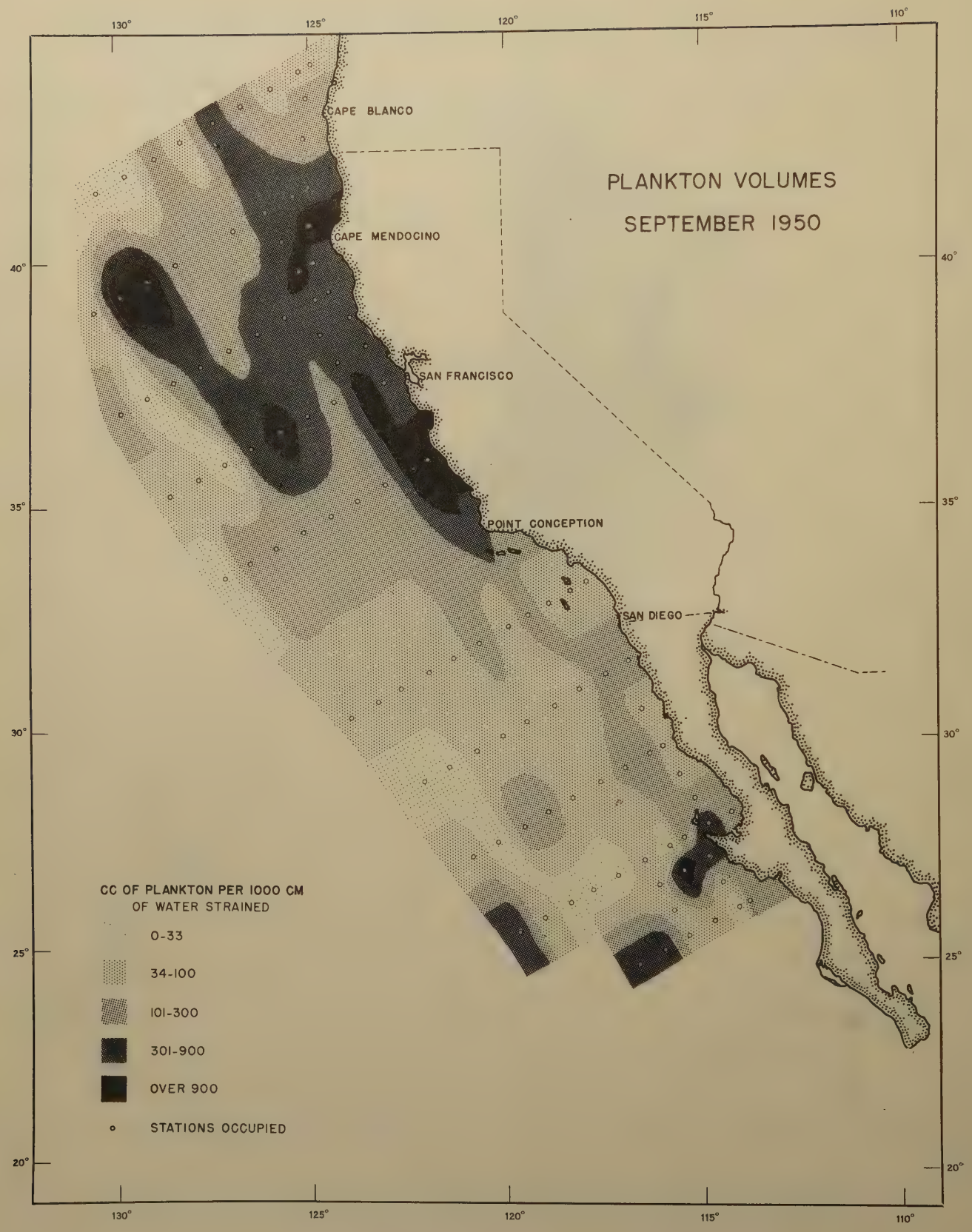
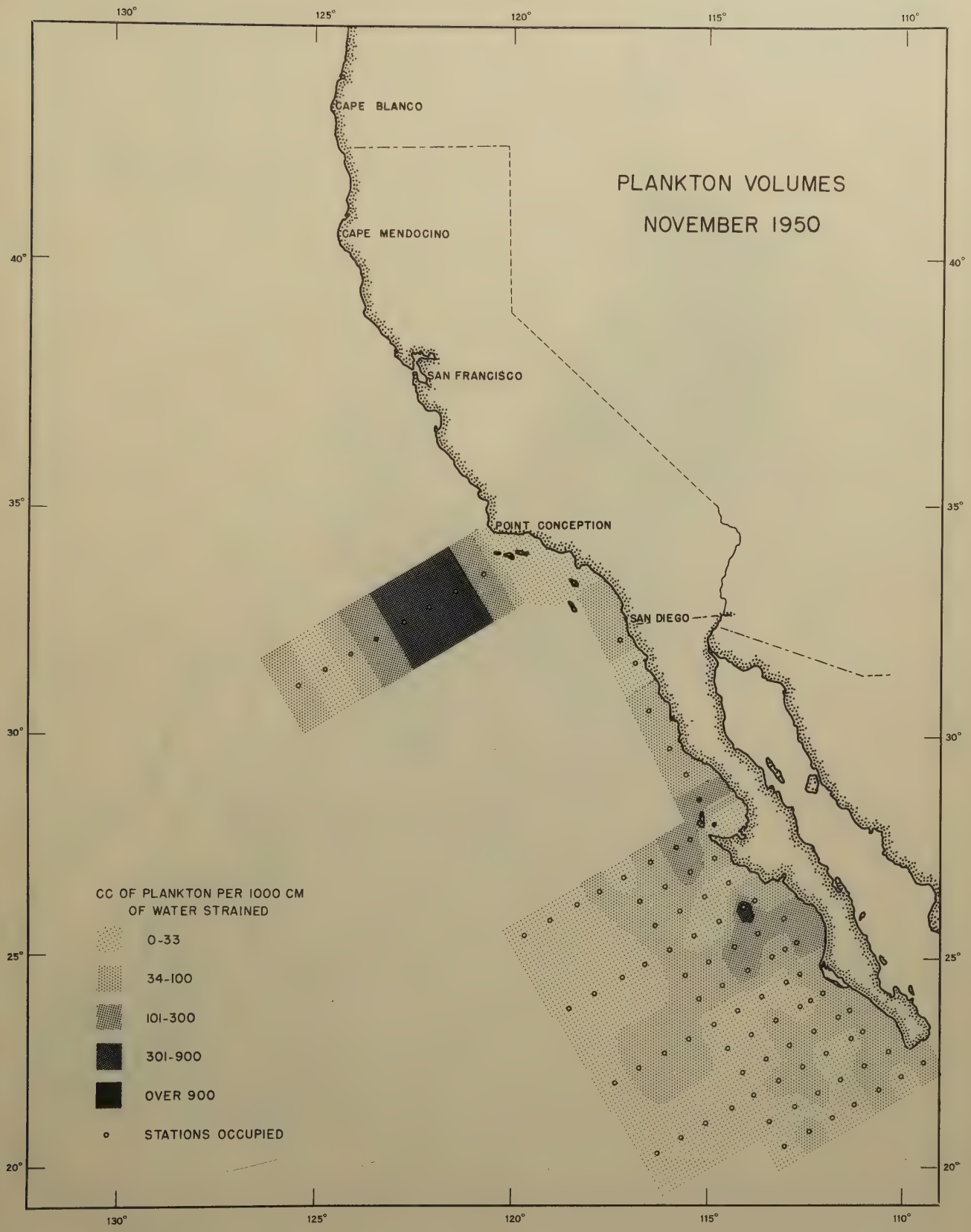
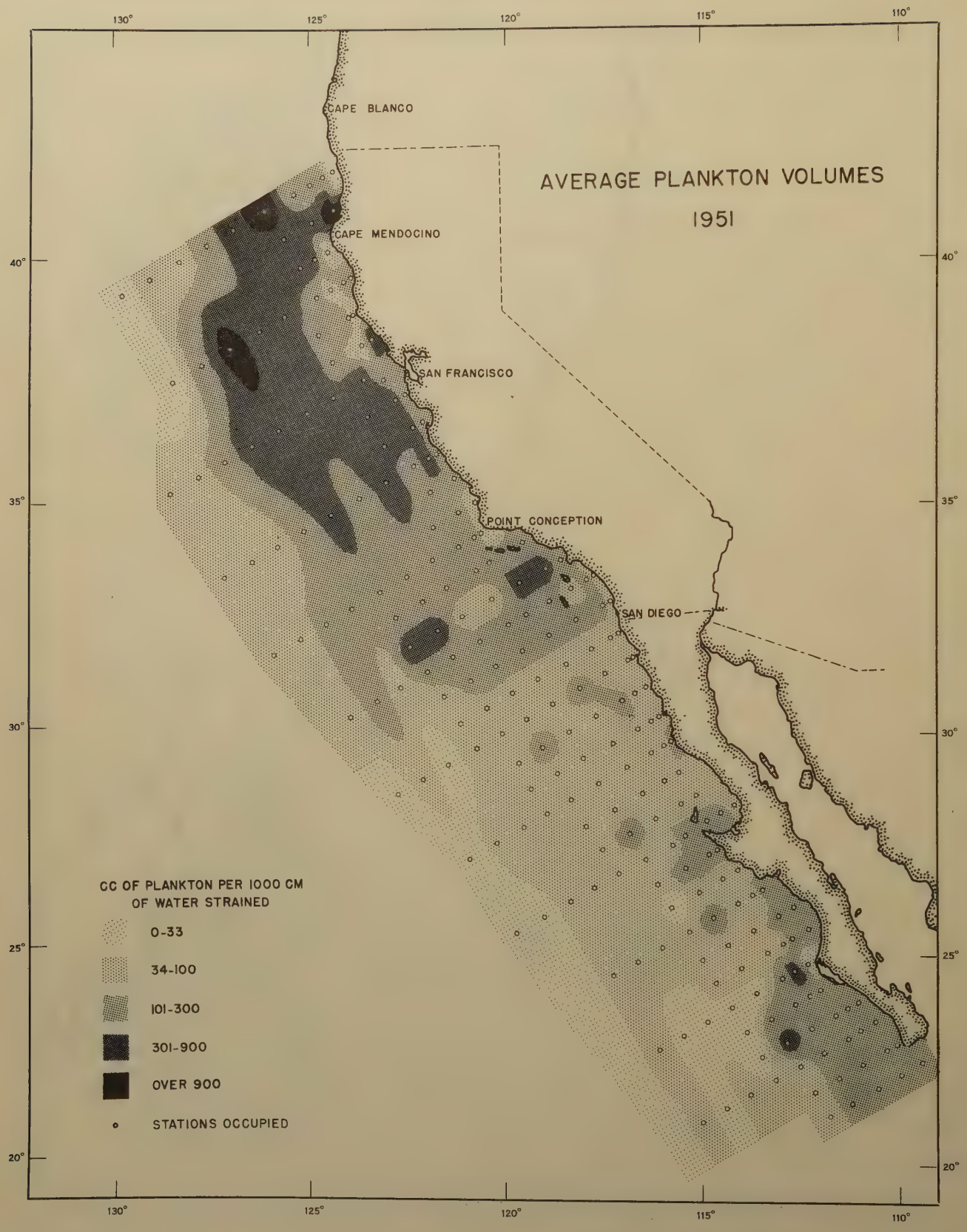
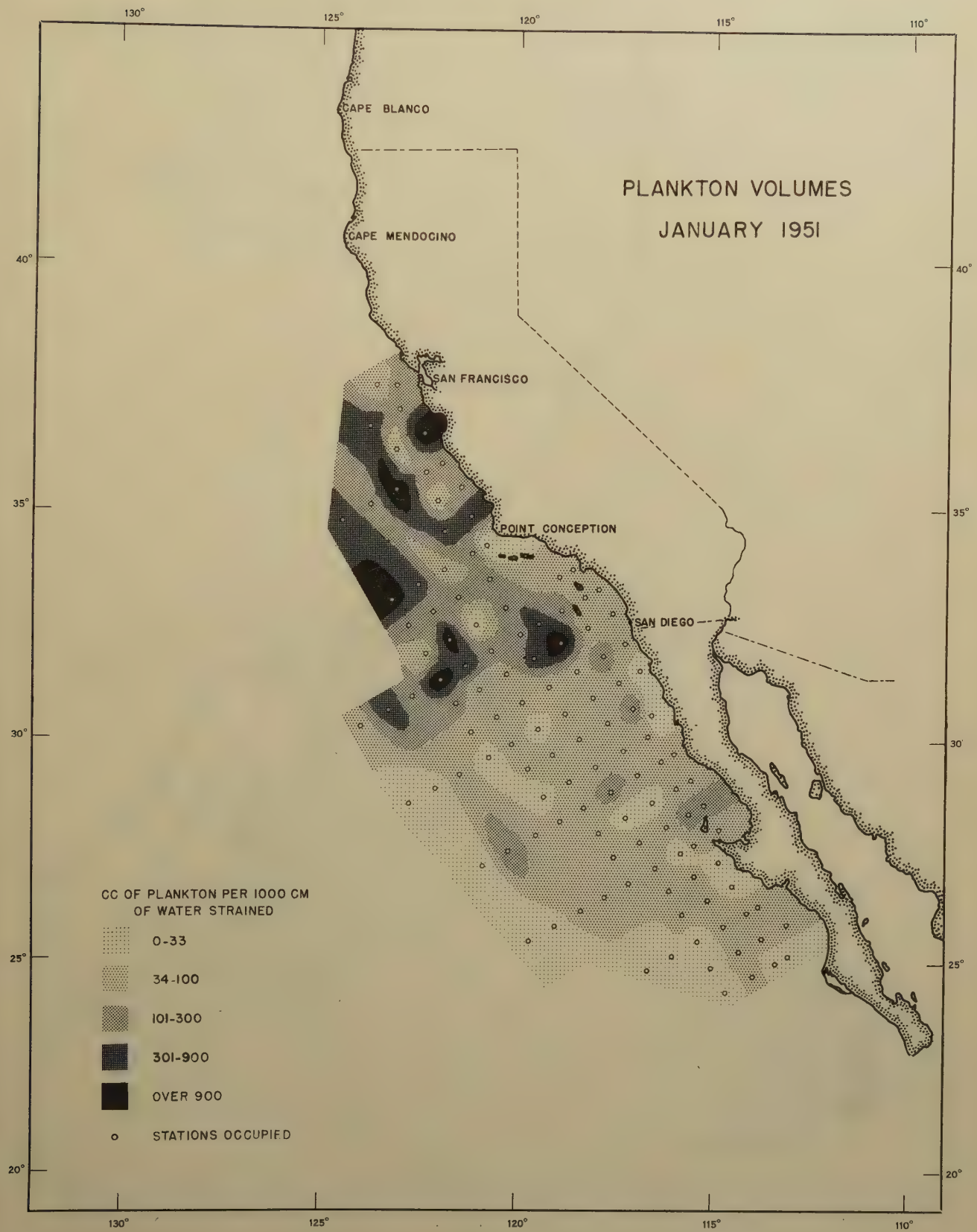

PLANKTON VOLUMES
JULY 1950
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED

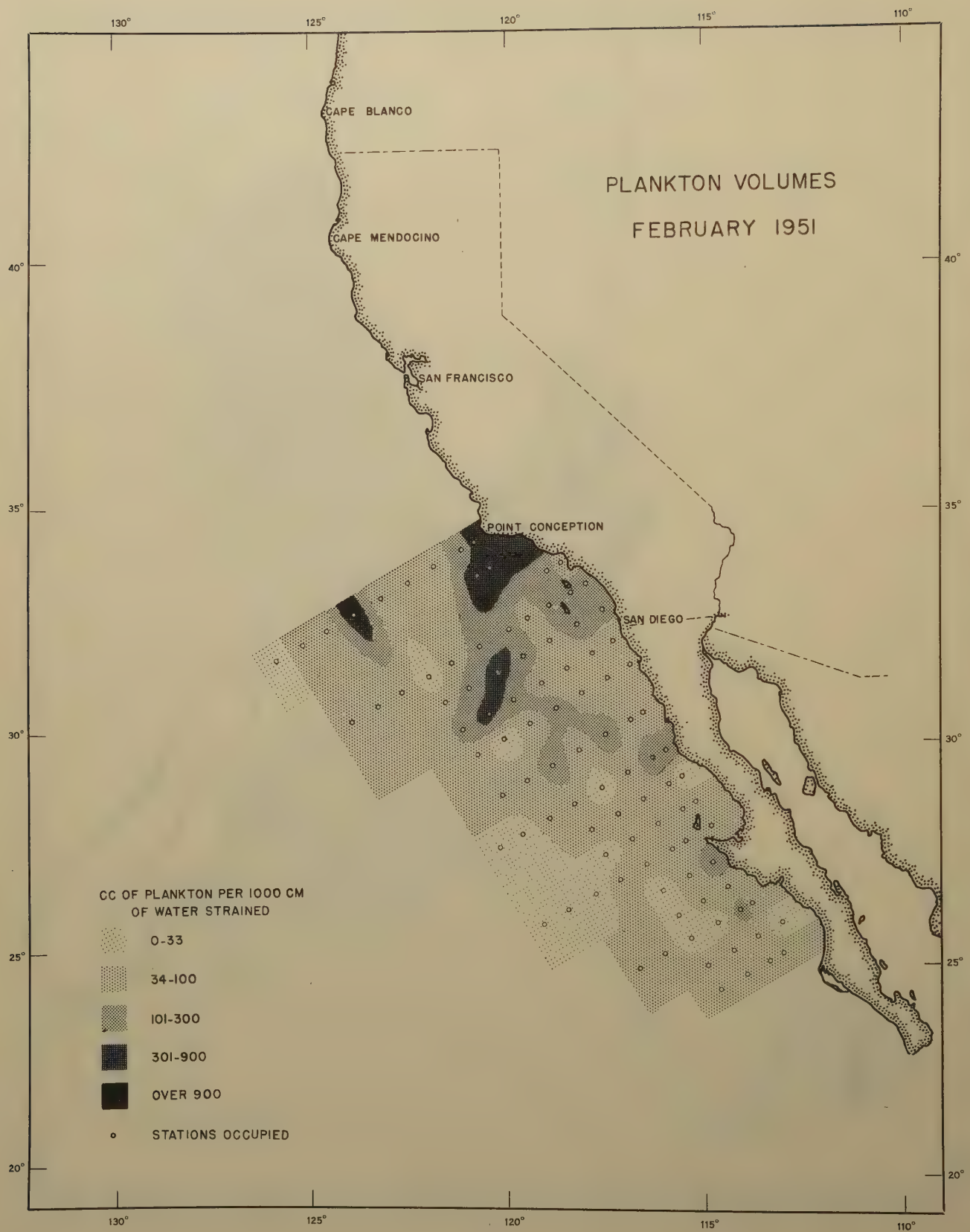

PLANKTON VOLUMES
AUGUST 1950
COLUMBIA R.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
PUNTA EUGENIA
135
130
125
120
115
110
45
40
35
30
25
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
SEPTEMBER 1950
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
NOVEMBER 1950
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


AVERAGE PLANKTON VOLUMES
1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JANUARY 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
FEBRUARY 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
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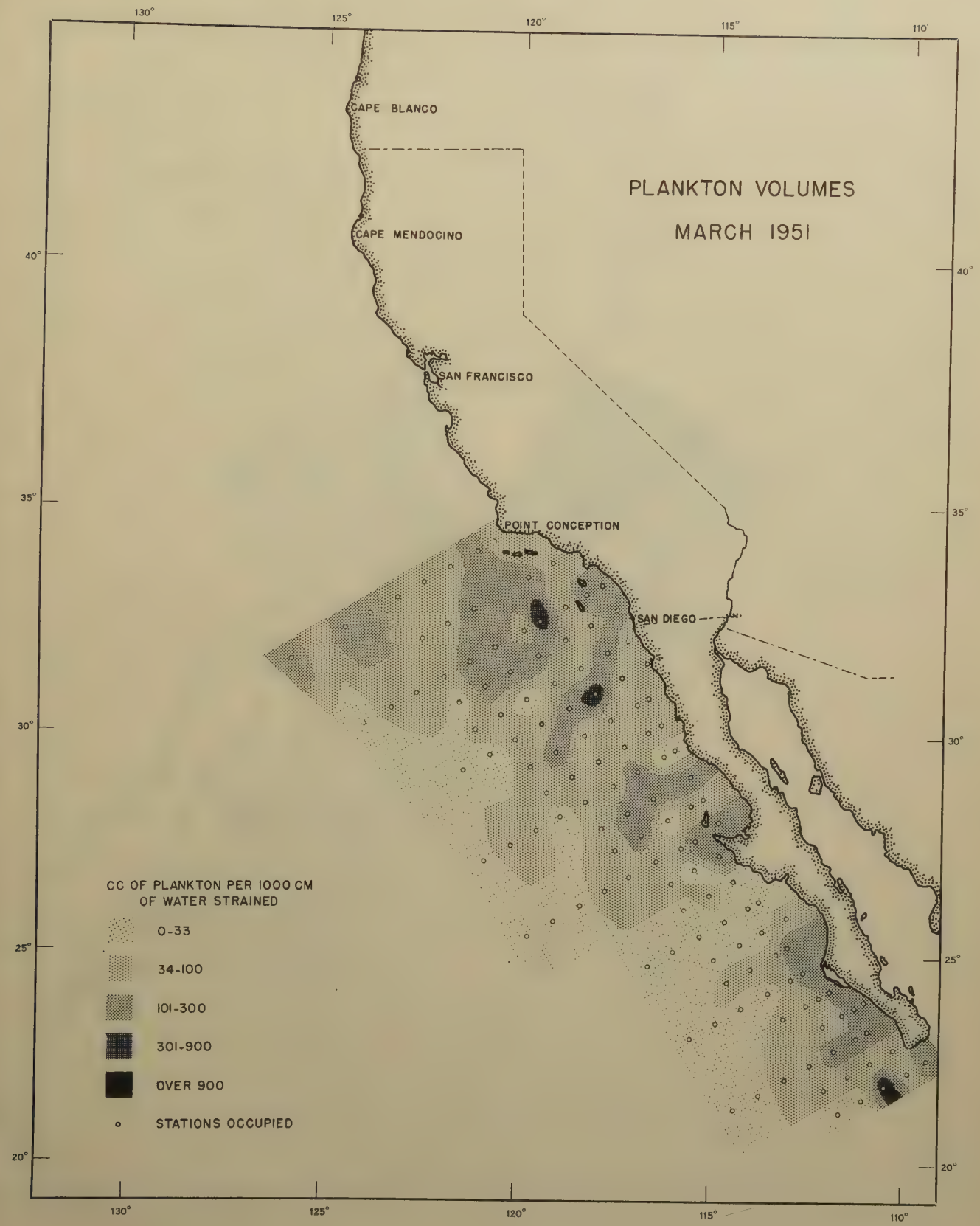
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MARCH 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
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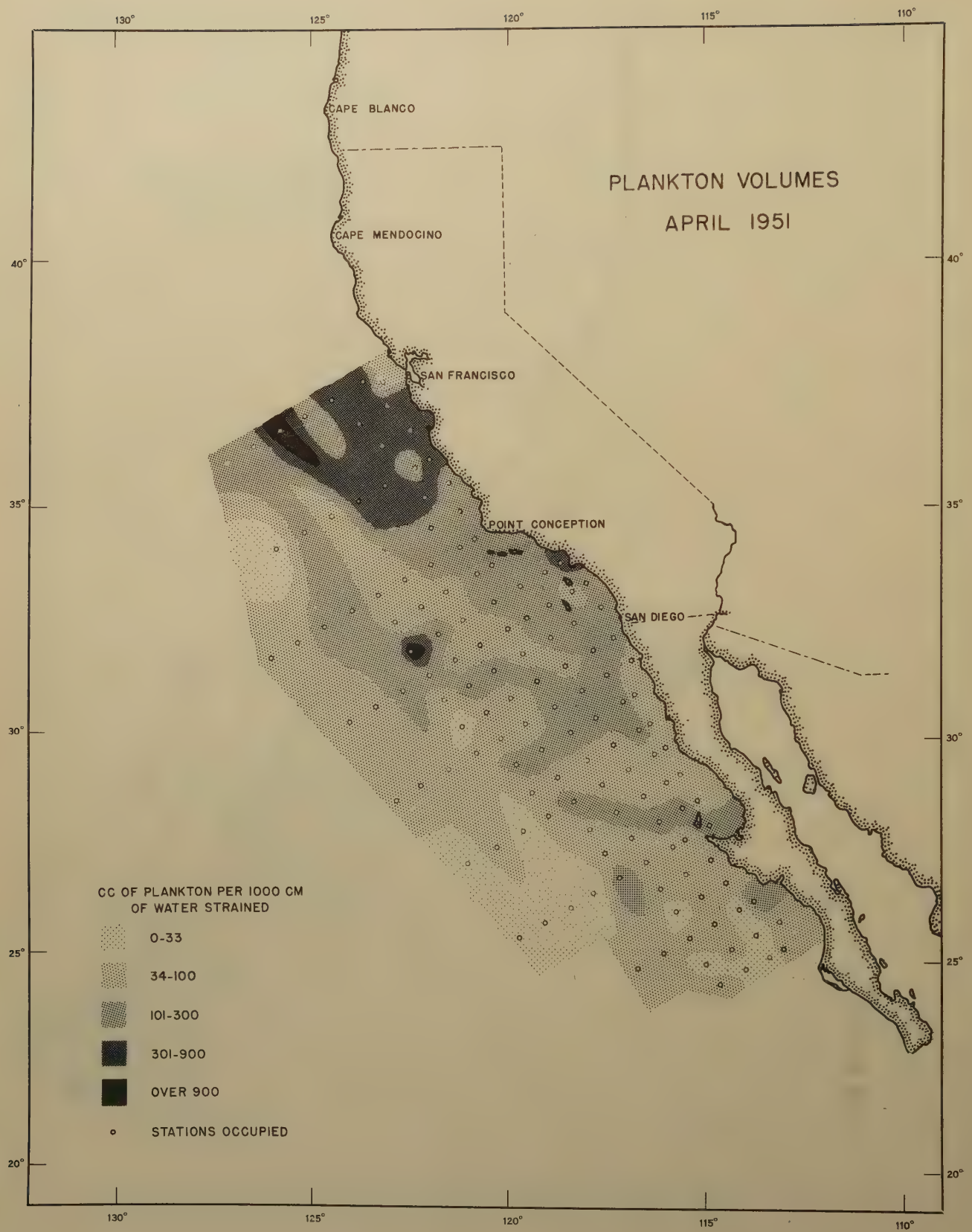
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
APRIL 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
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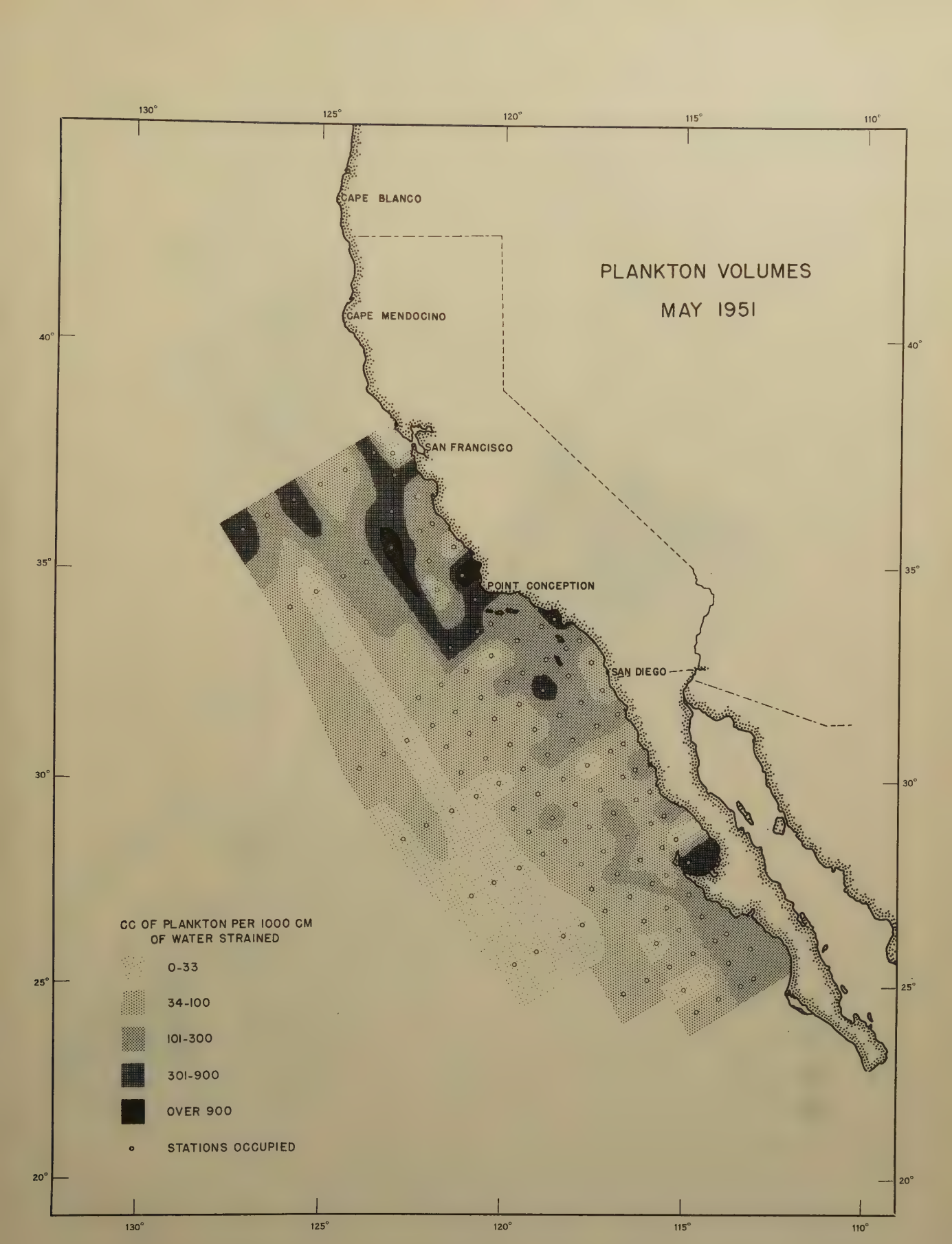
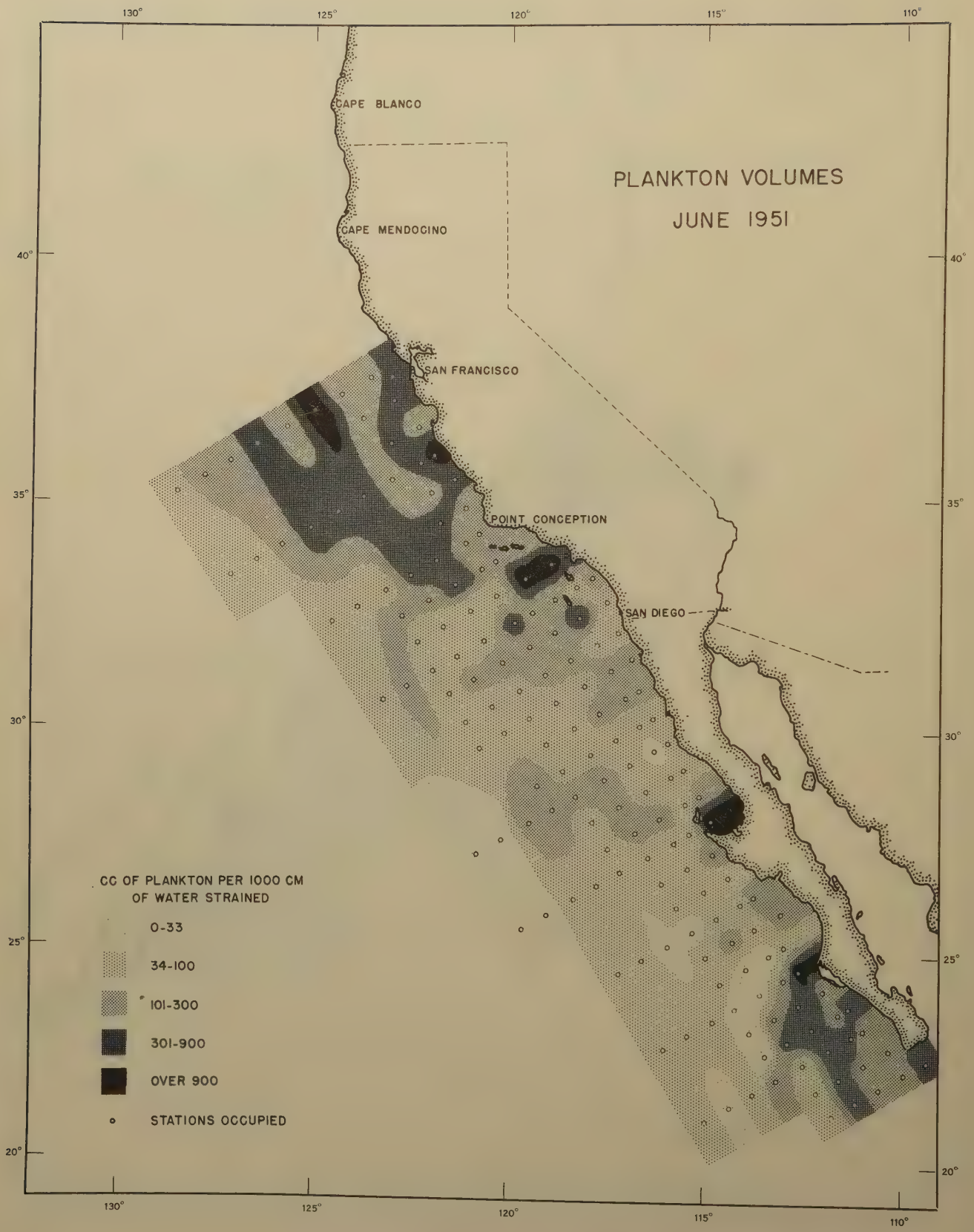
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MAY 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JUNE 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
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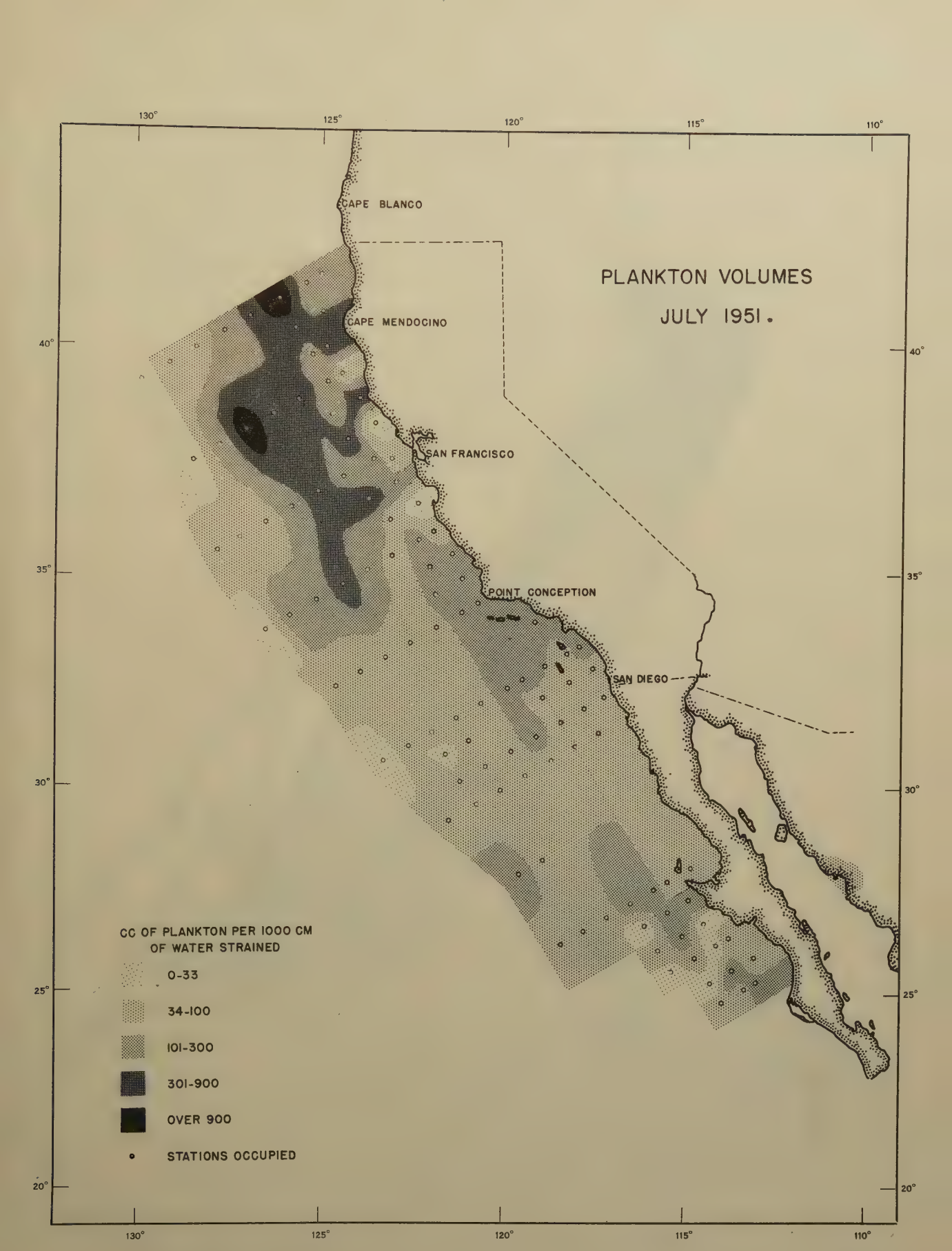
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JULY 1951.
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
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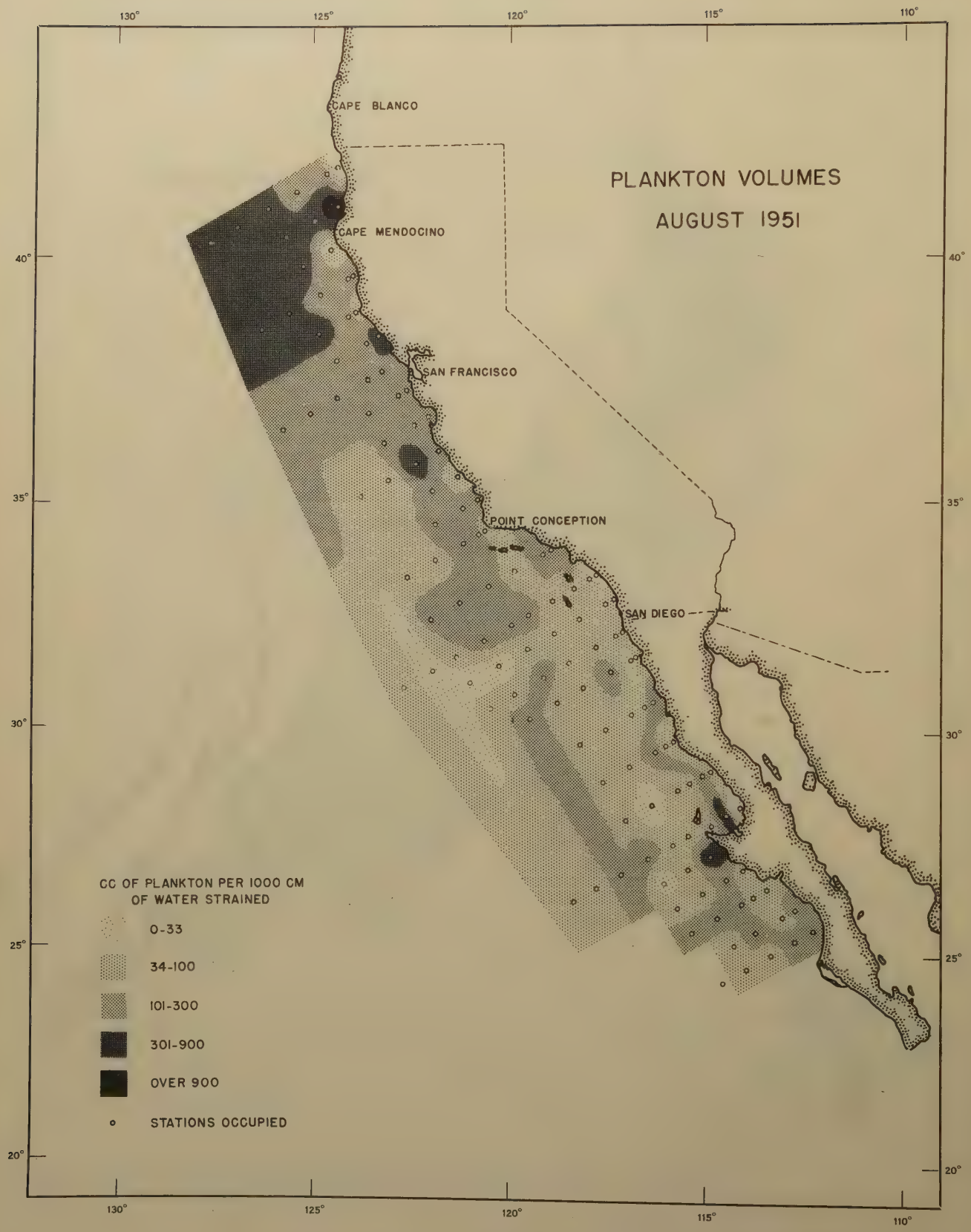
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
AUGUST 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
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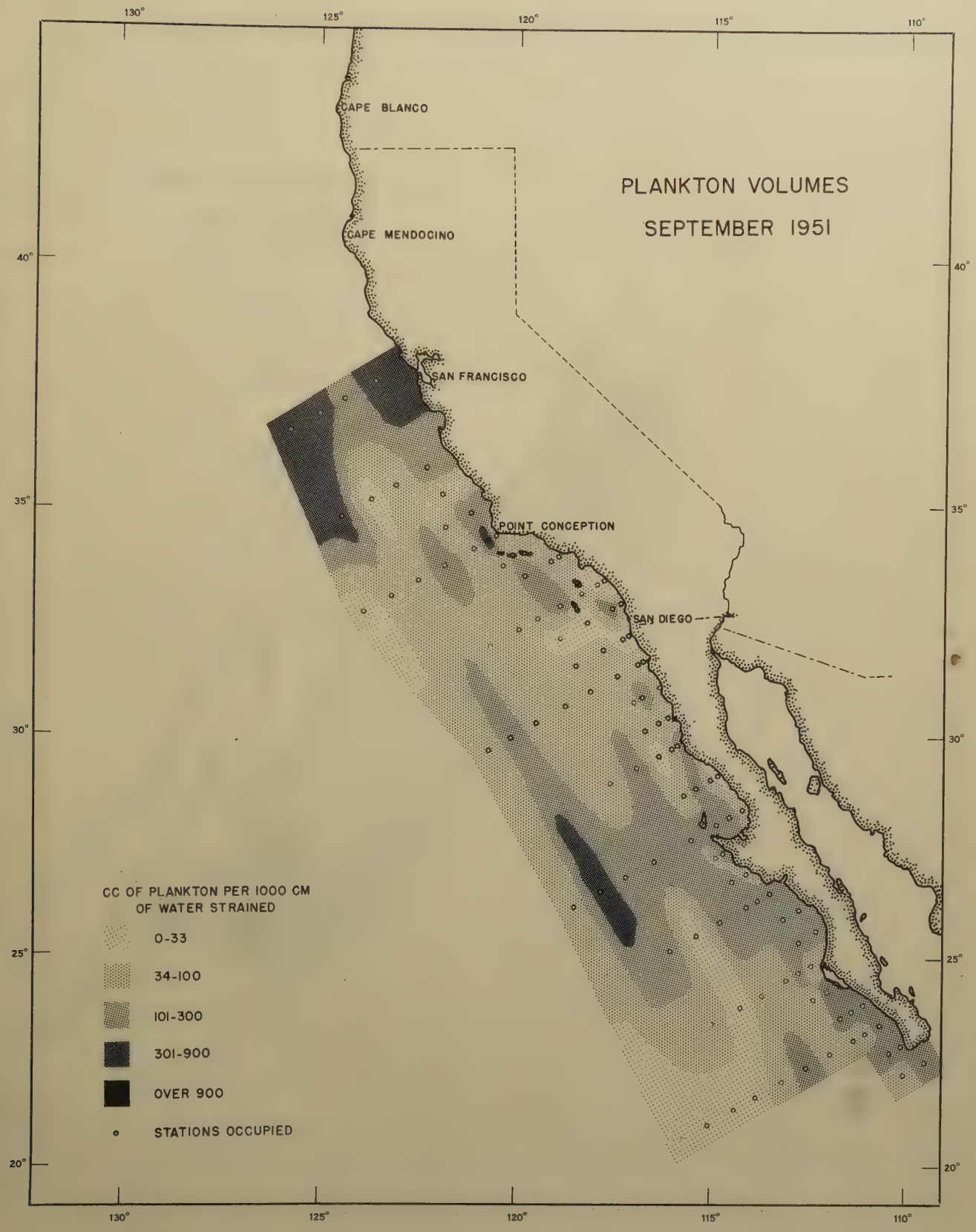
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
SEPTEMBER 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
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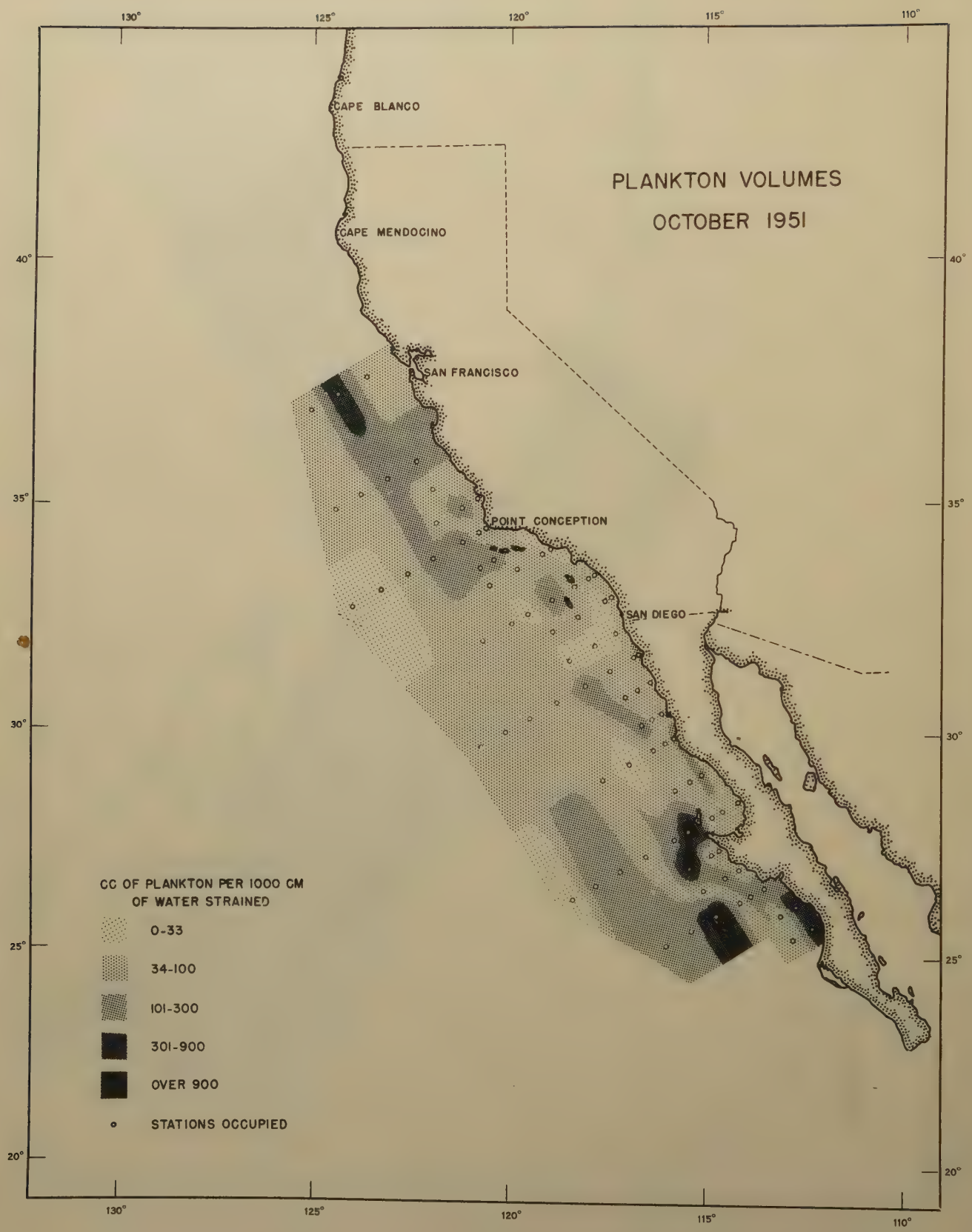
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
OCTOBER 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
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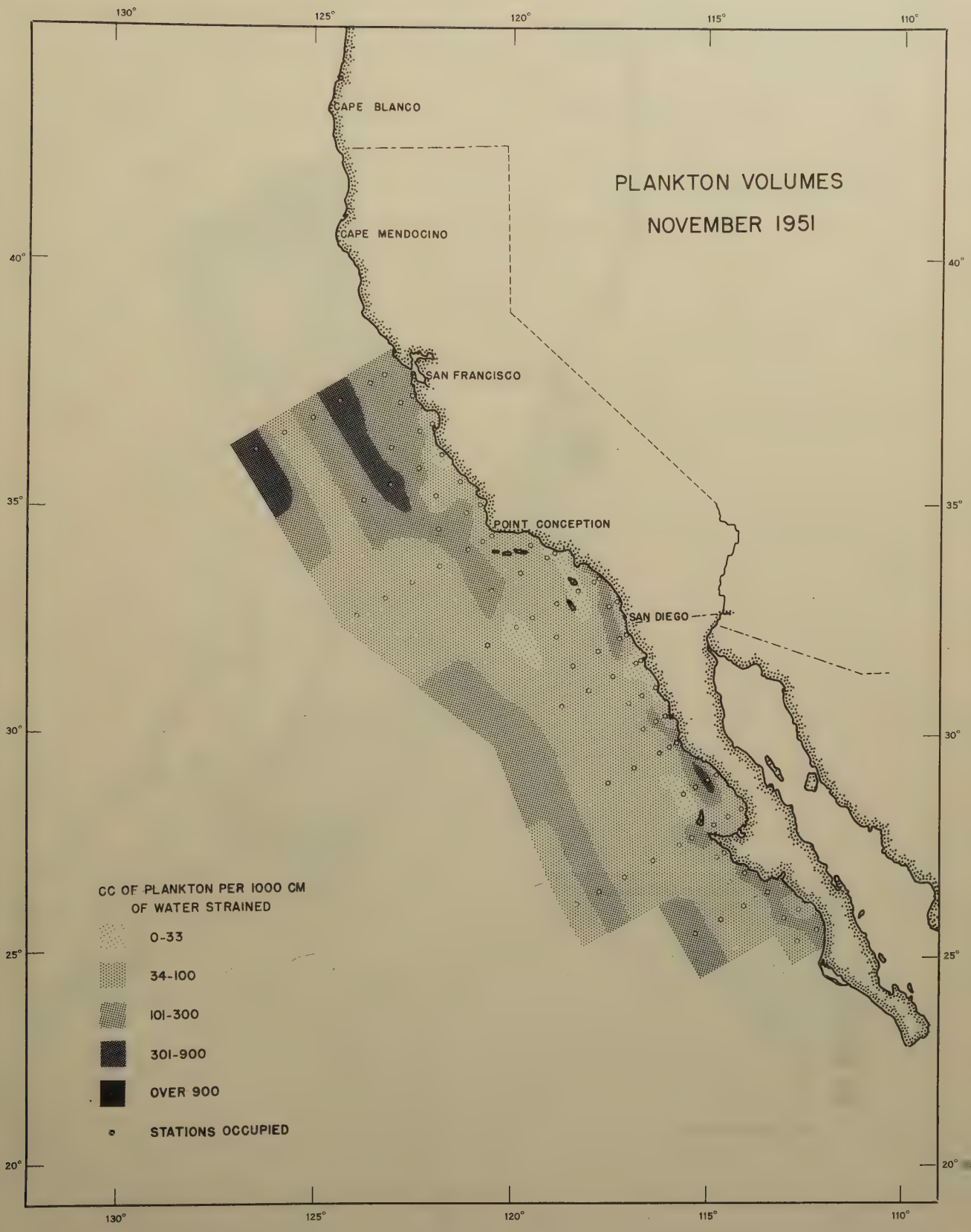
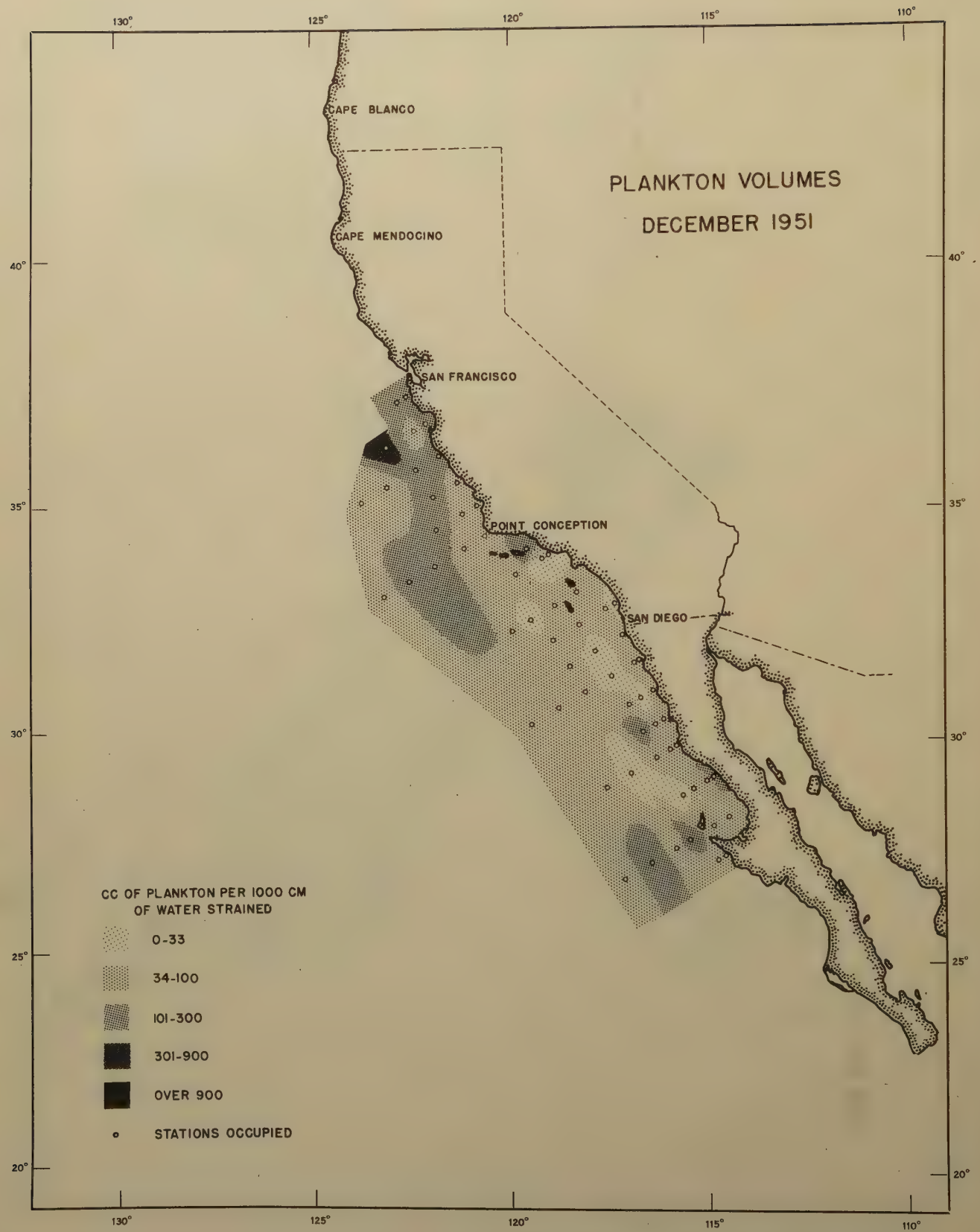
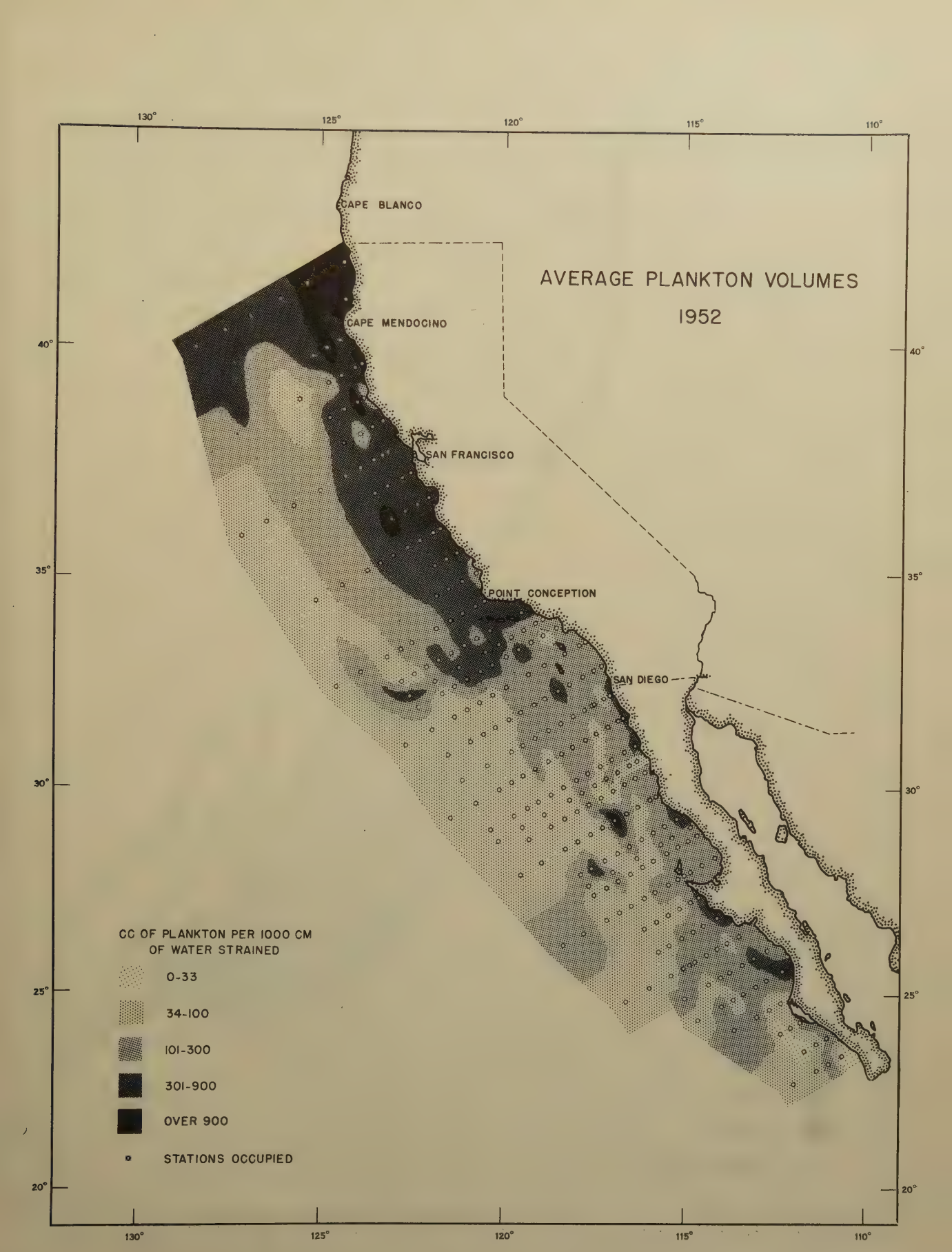
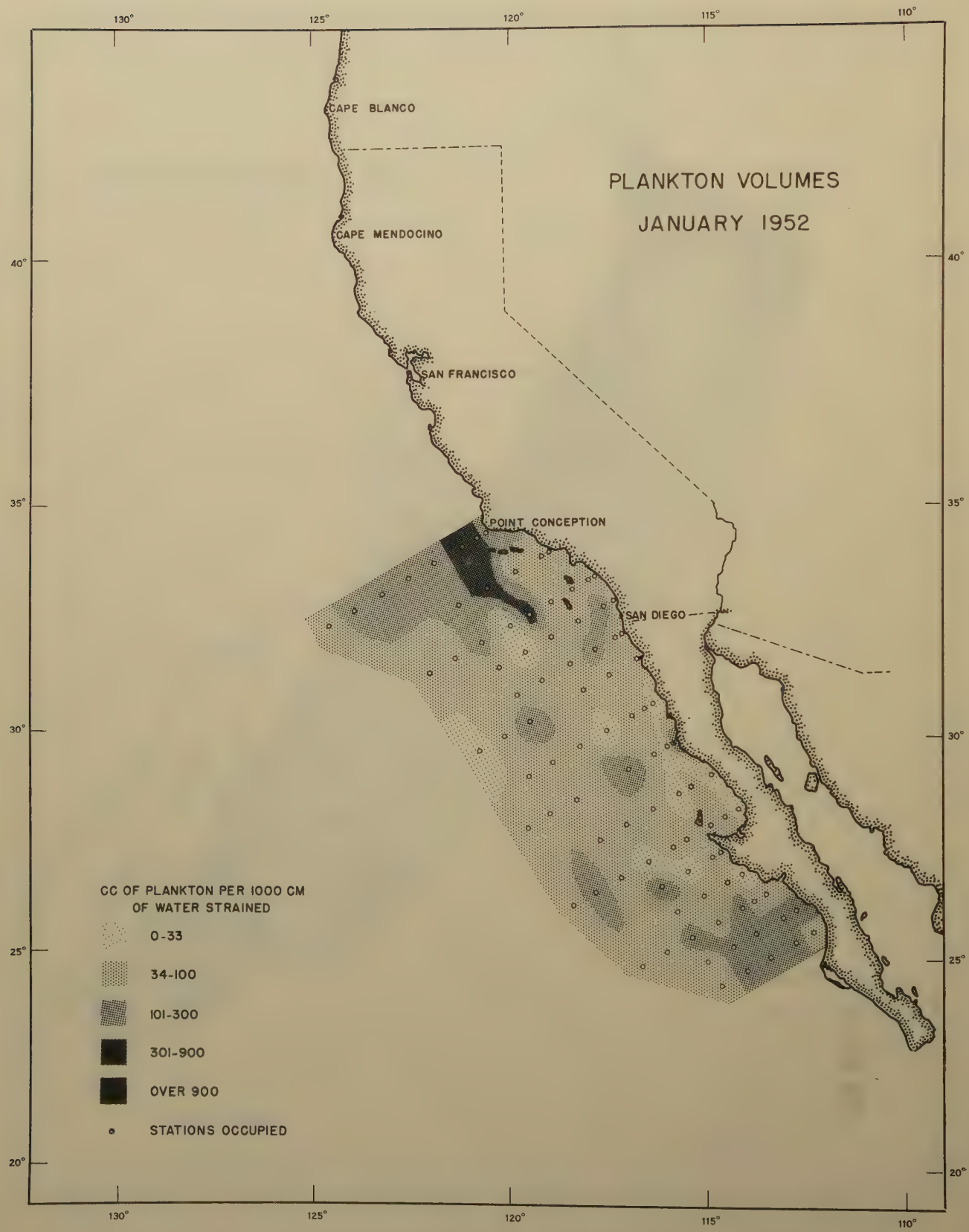
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
NOVEMBER 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
DECEMBER 1951
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


AVERAGE PLANKTON VOLUMES
1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JANUARY 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
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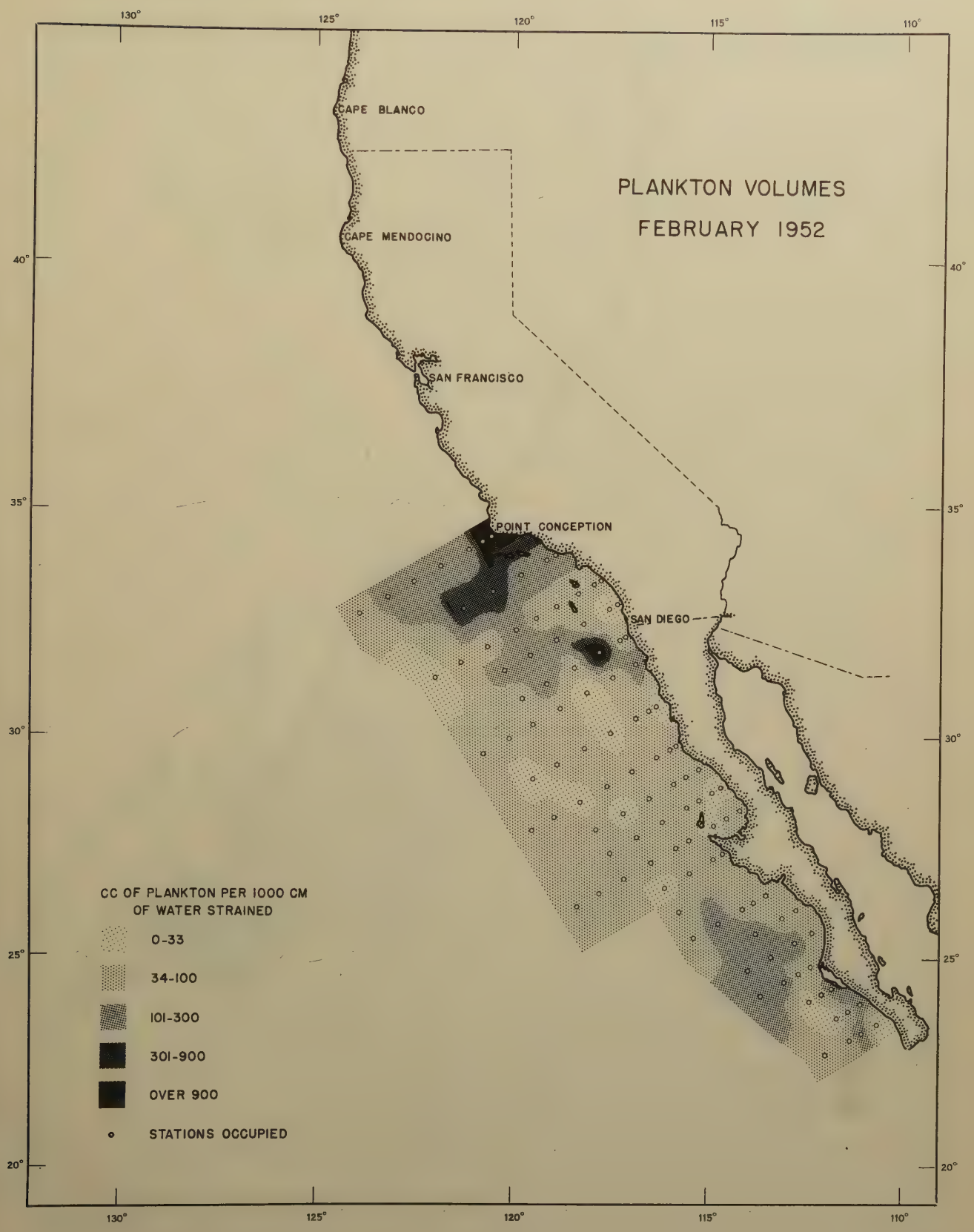
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
FEBRUARY 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
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20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
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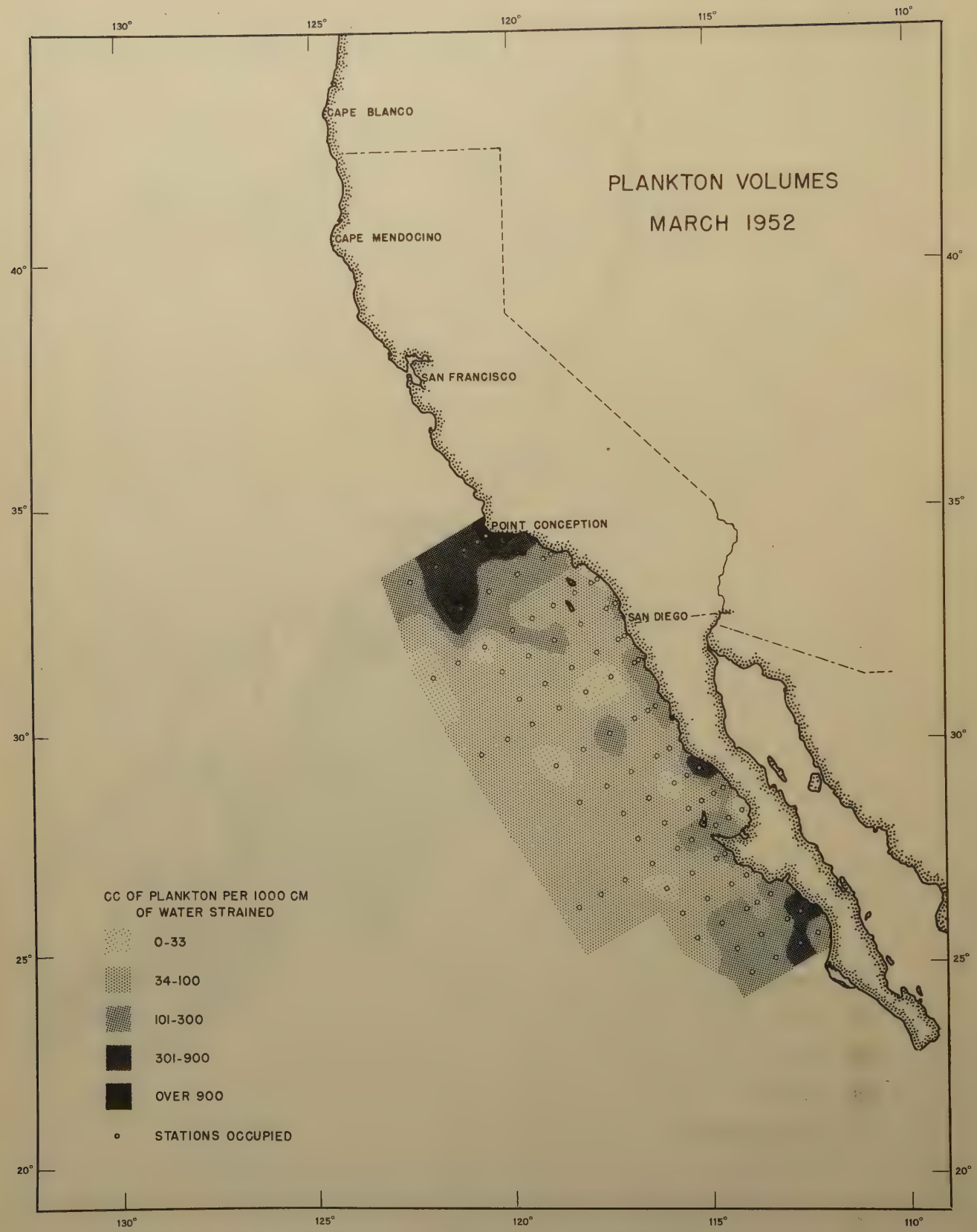
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MARCH 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
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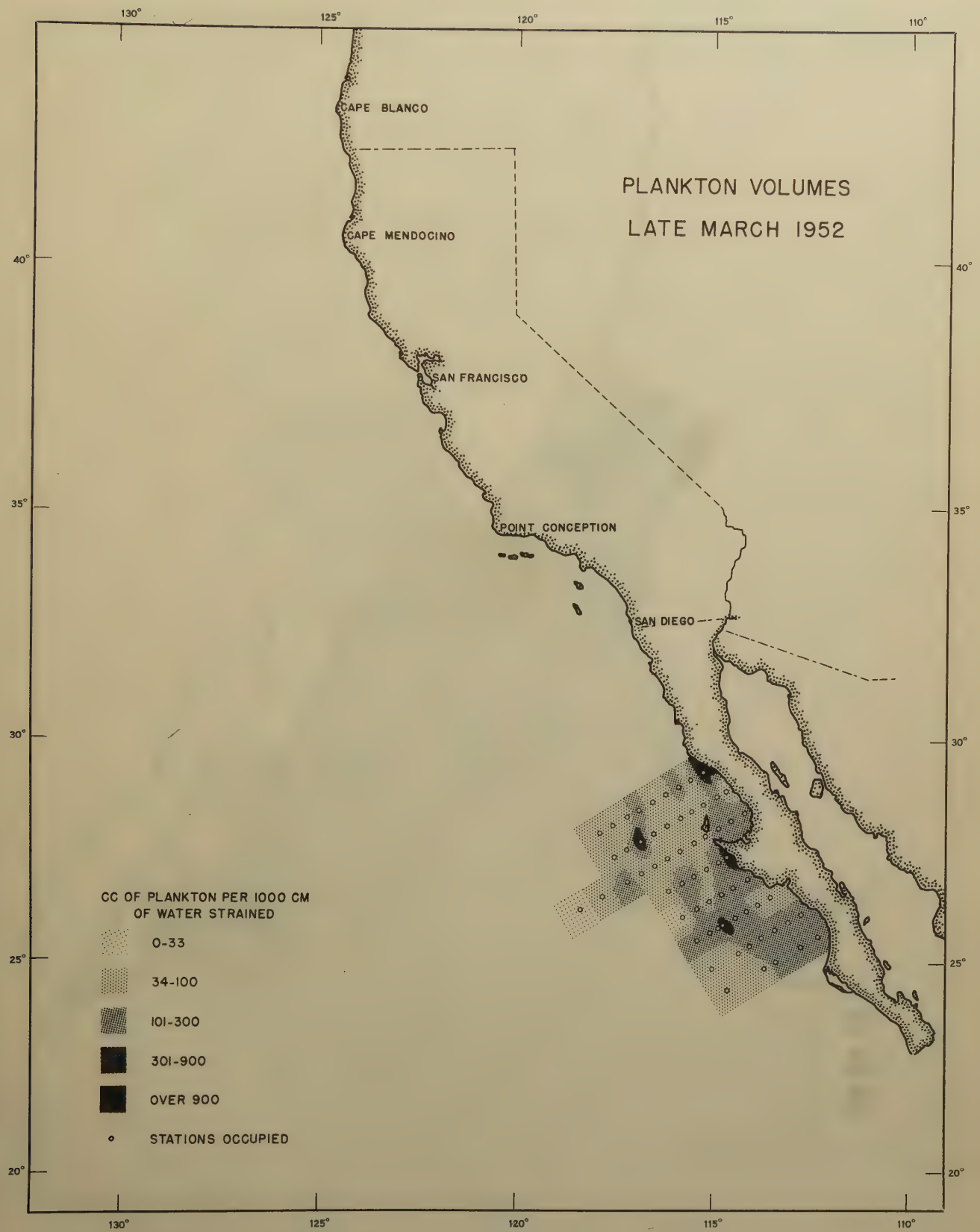
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
LATE MARCH 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
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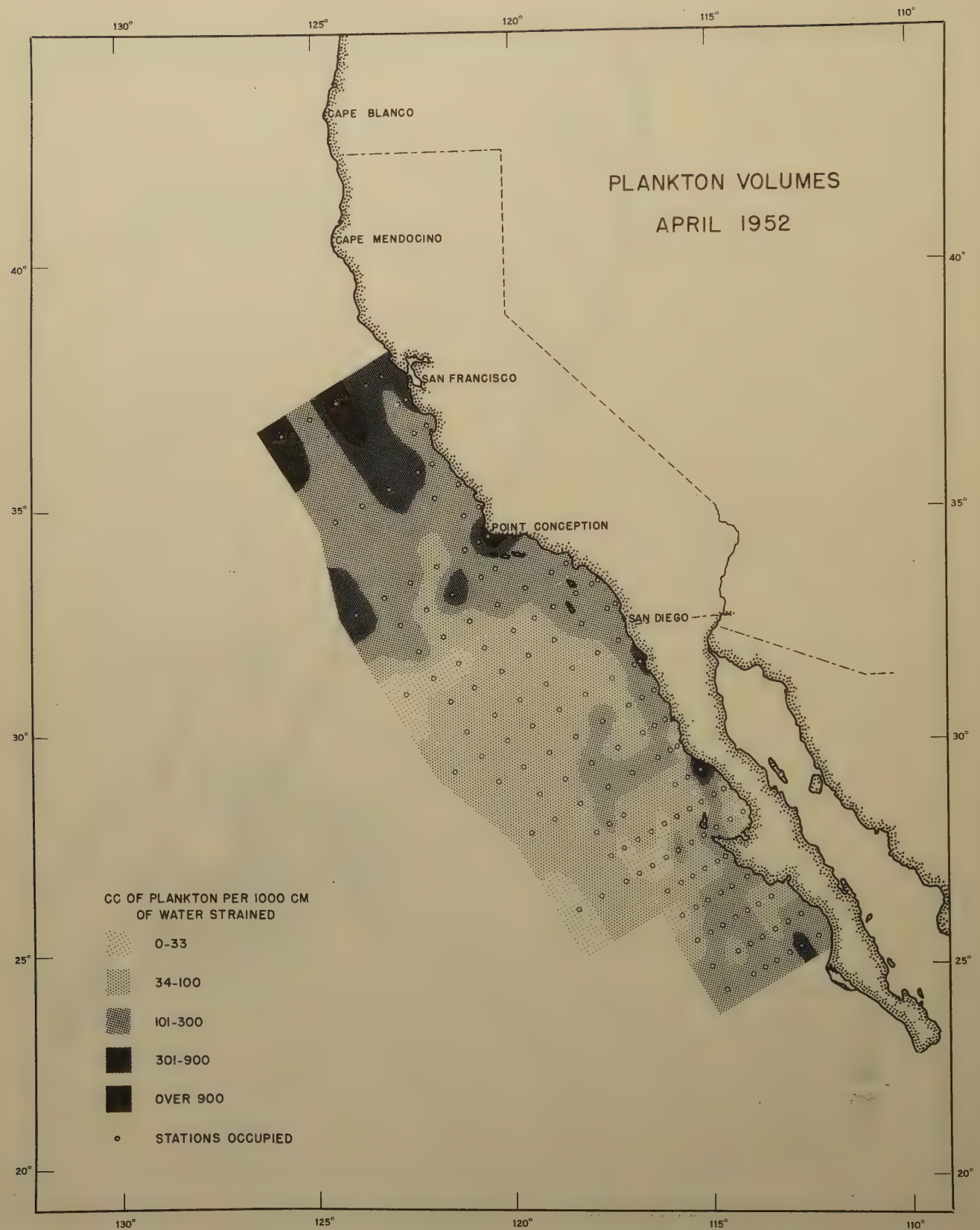
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
APRIL 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
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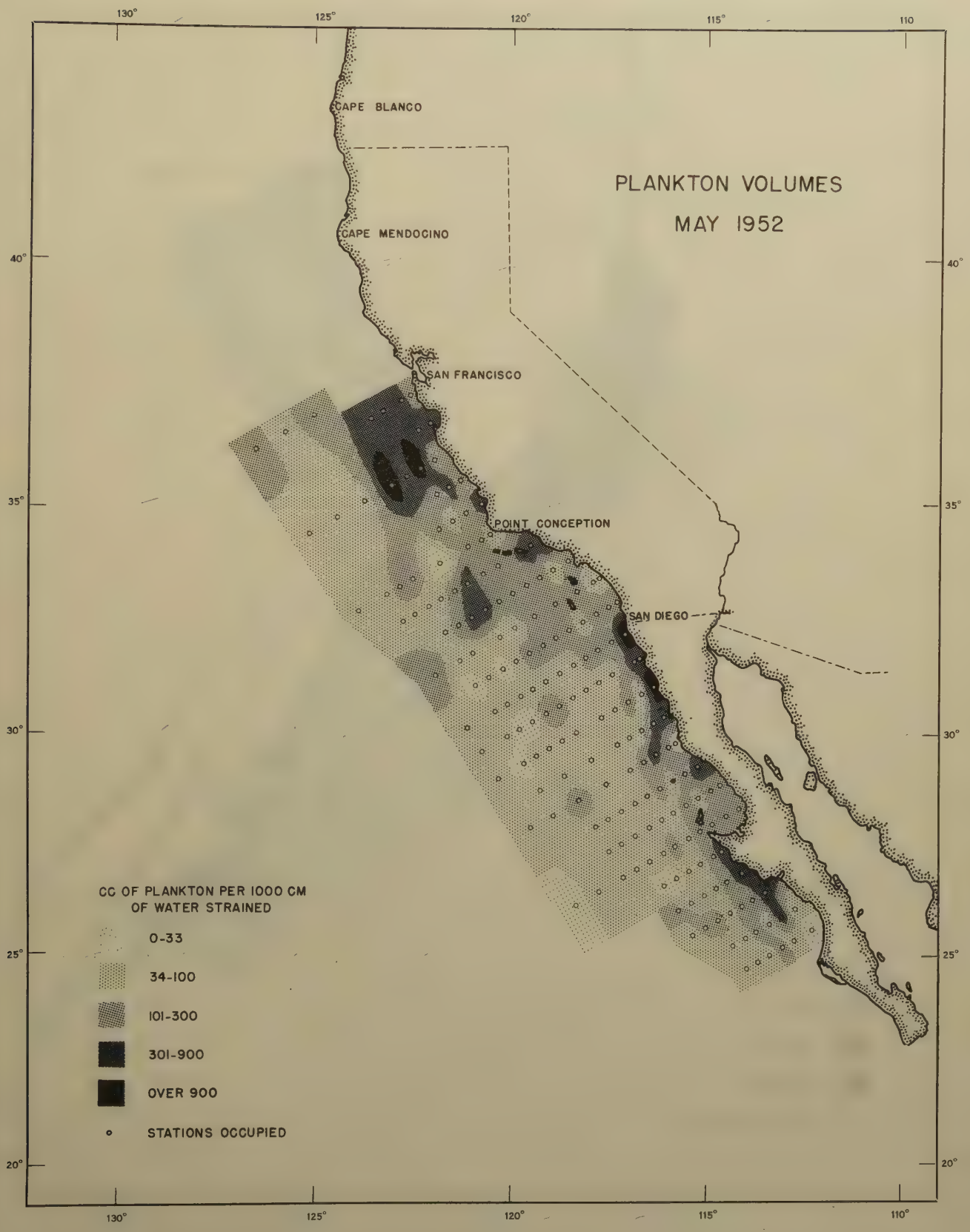
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MAY 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
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40°
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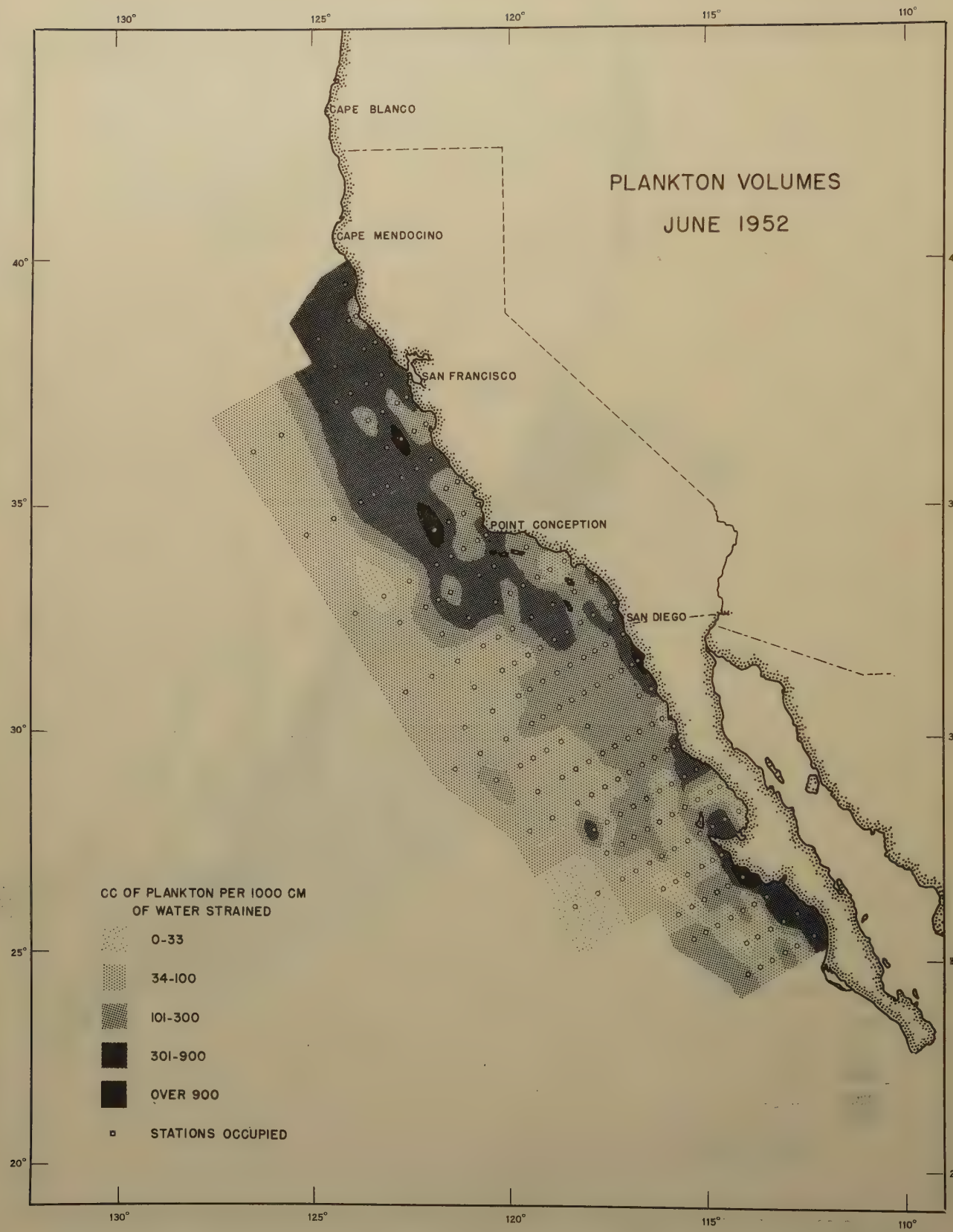
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JUNE 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
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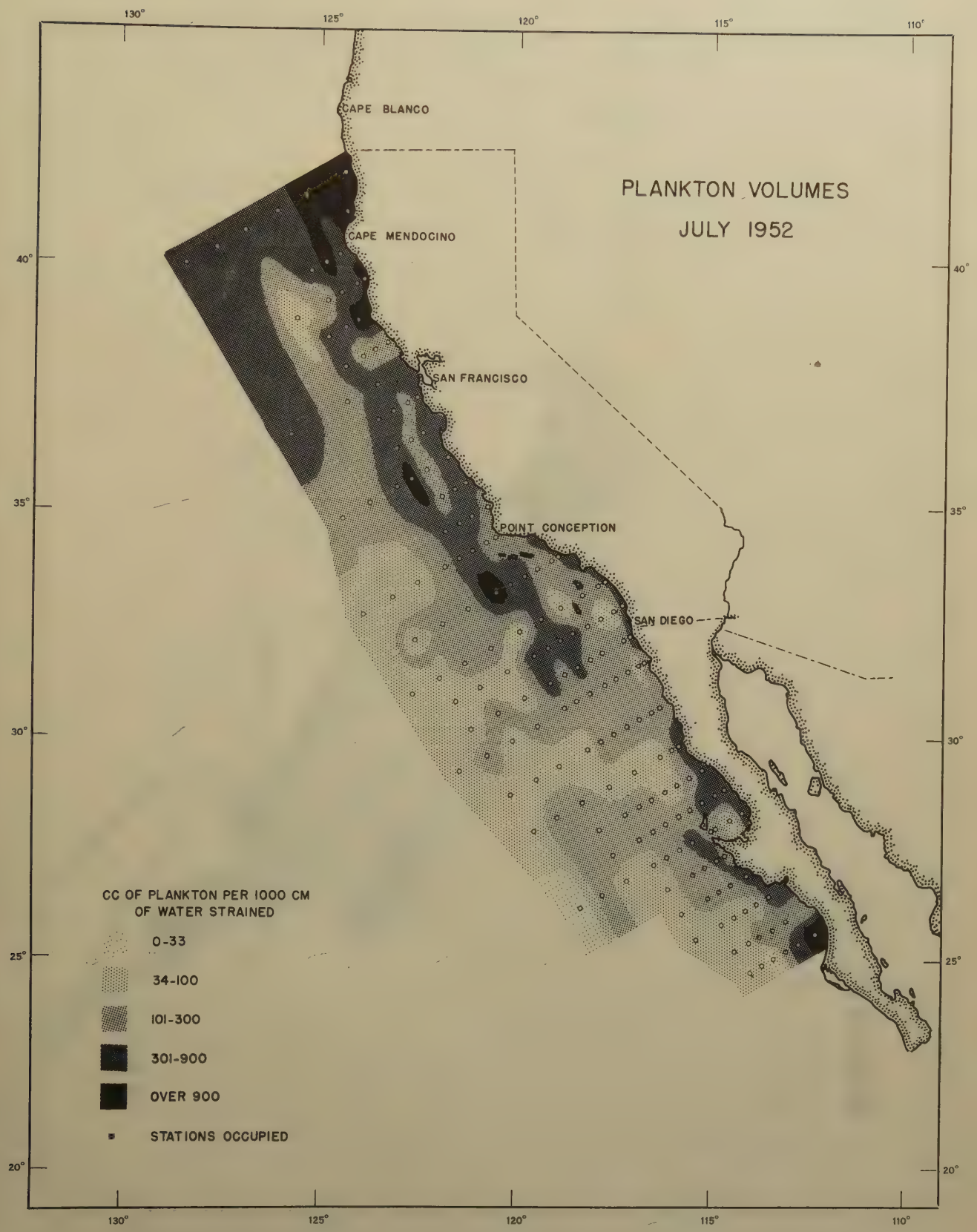
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JULY 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
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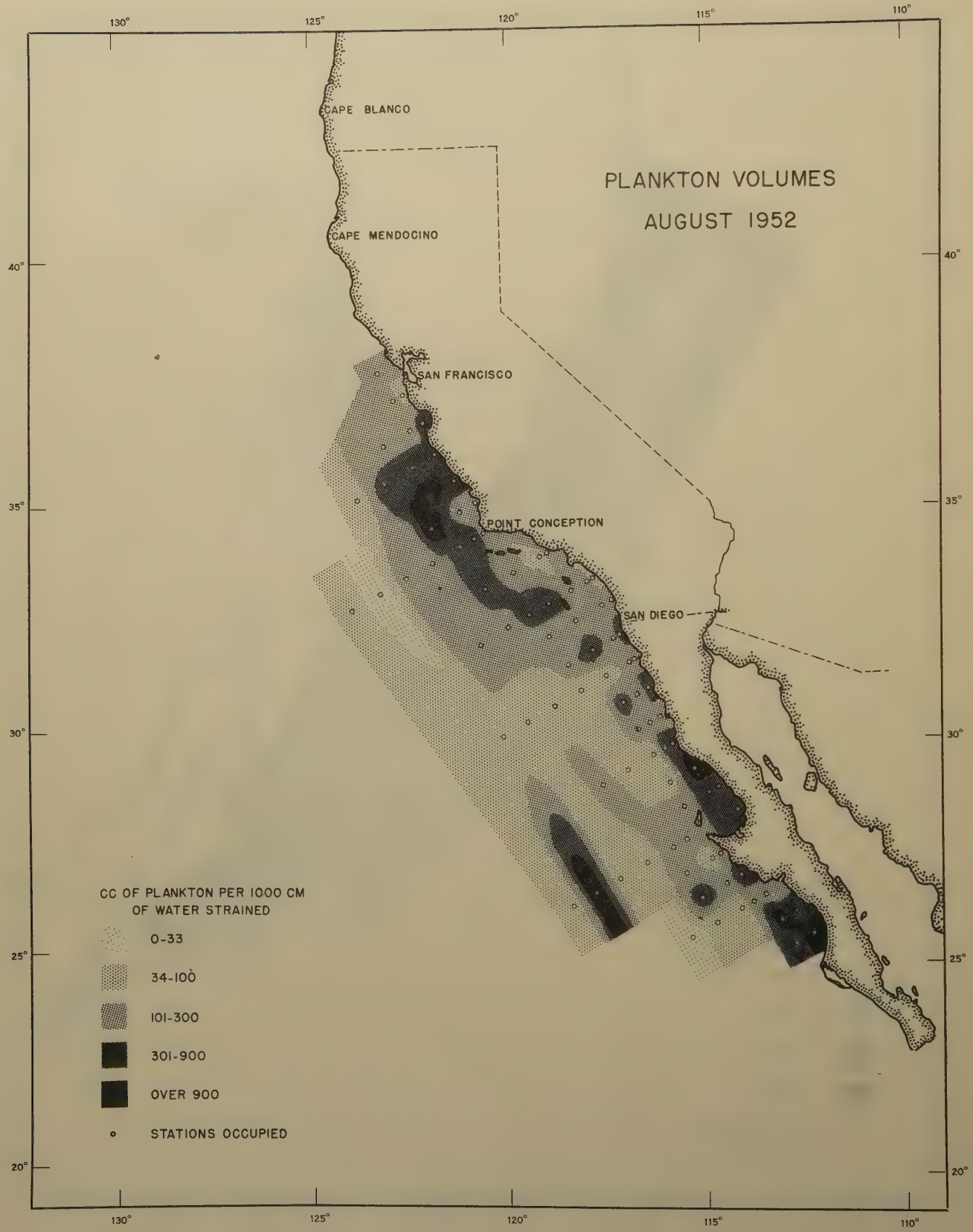
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
AUGUST 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
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20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
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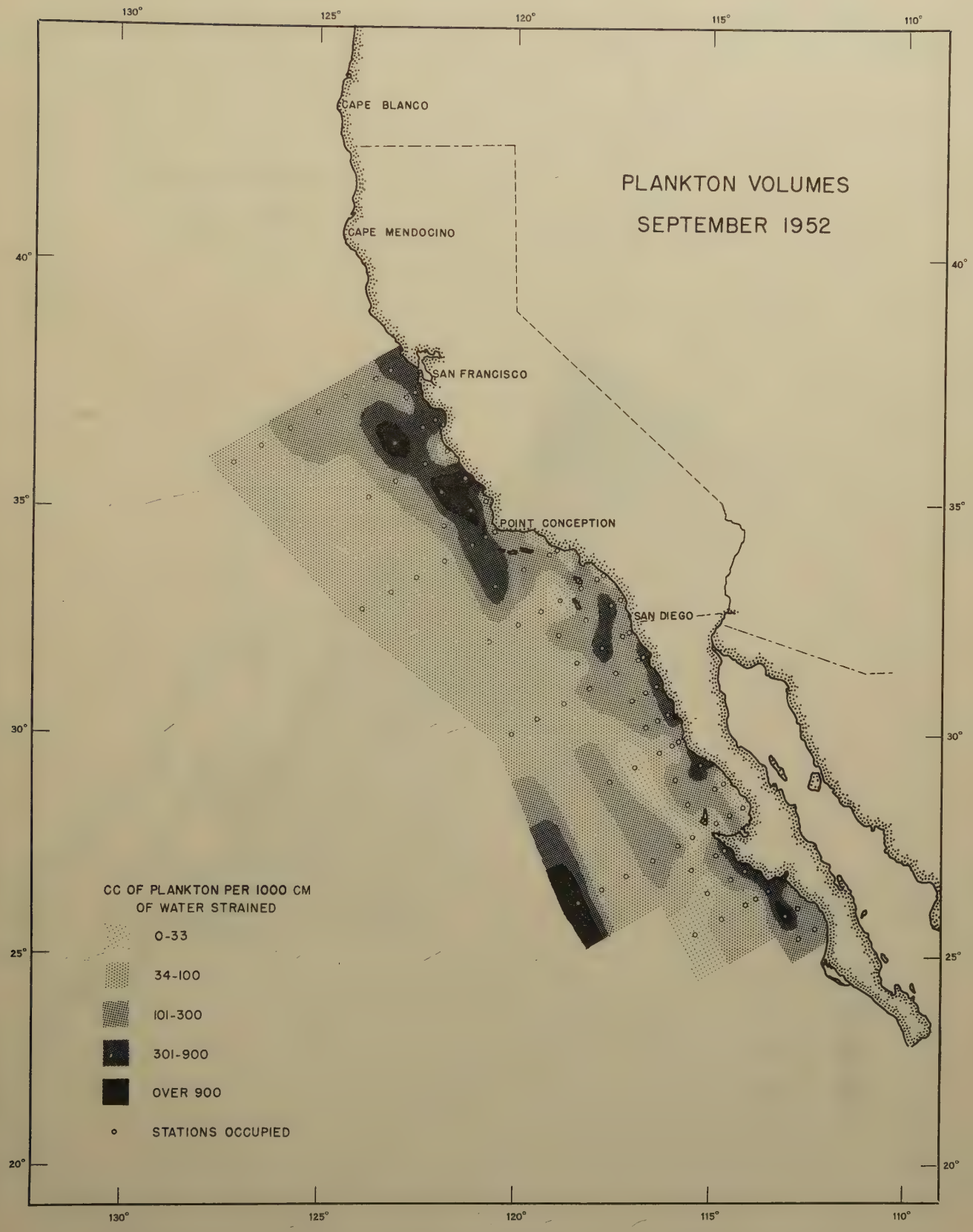
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
SEPTEMBER 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
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115°
110°
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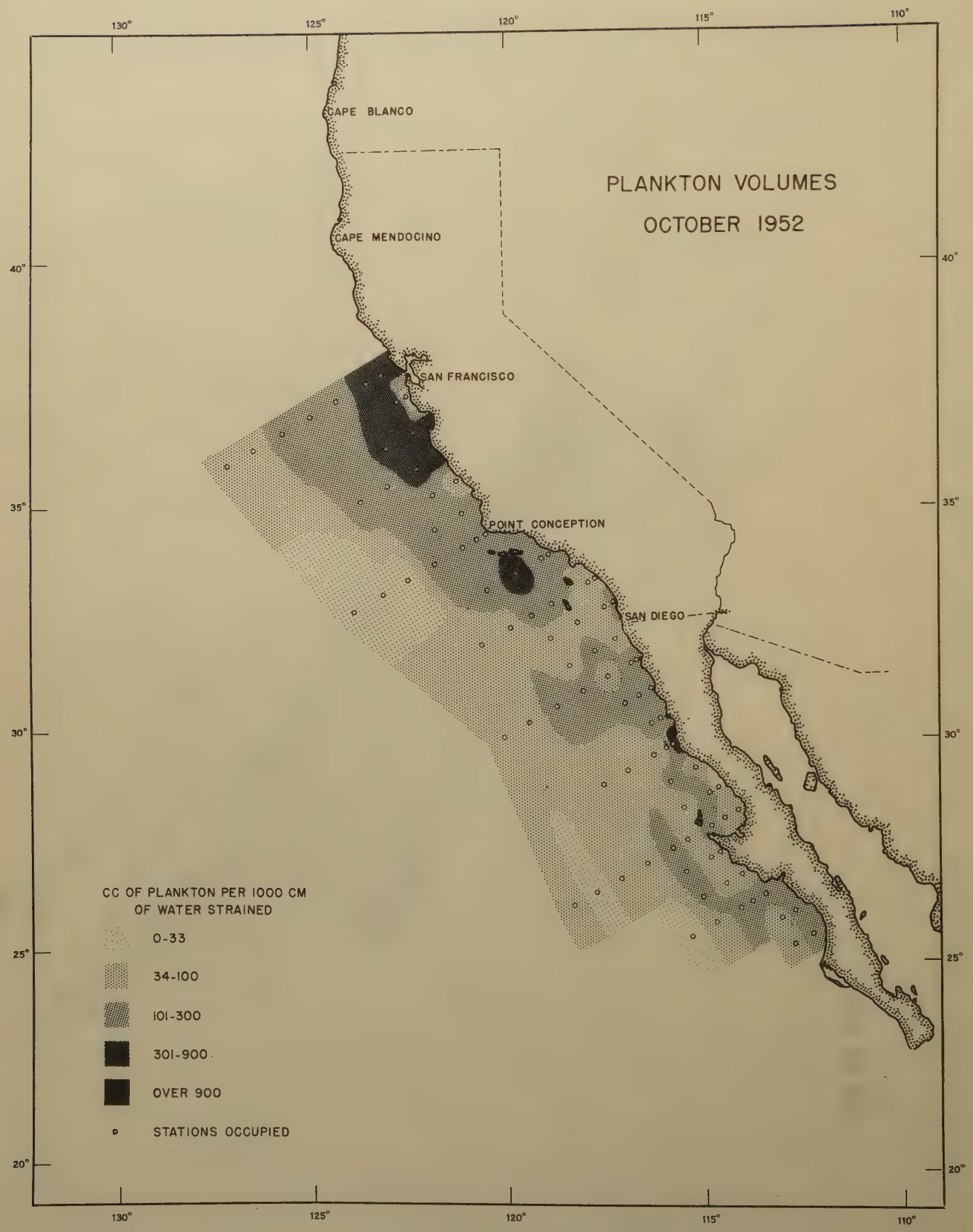
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
OCTOBER 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
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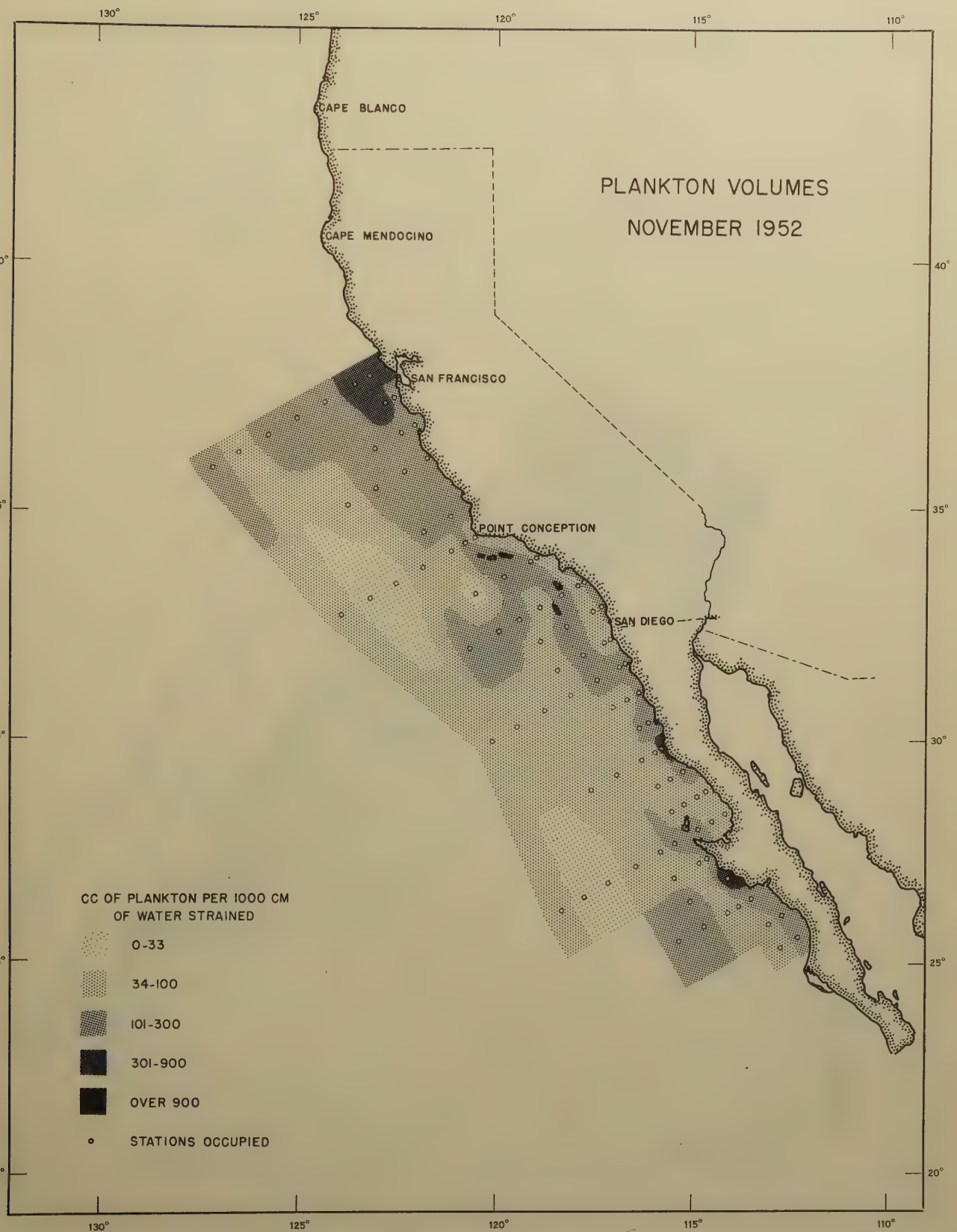
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
NOVEMBER 1952
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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115°
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CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
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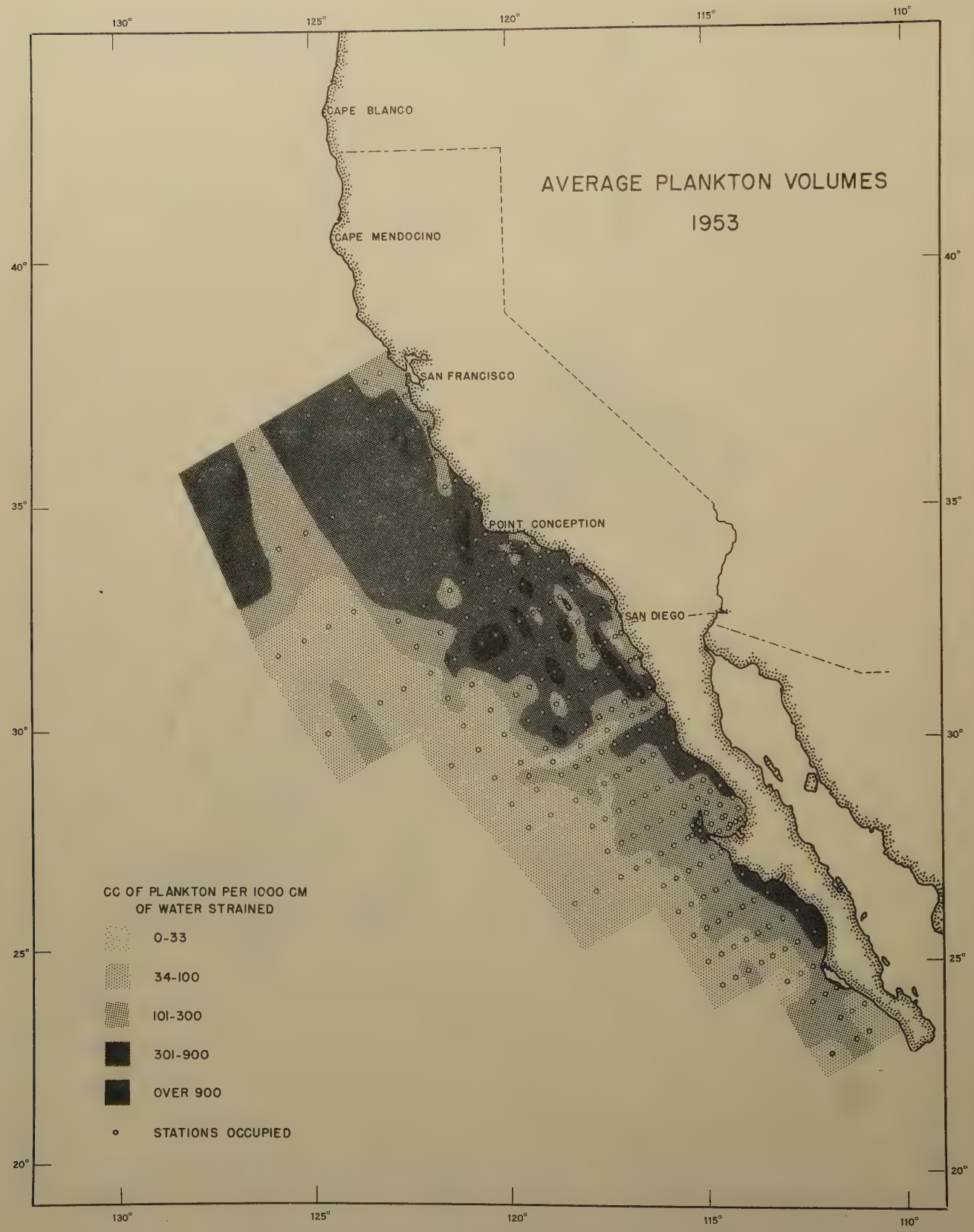
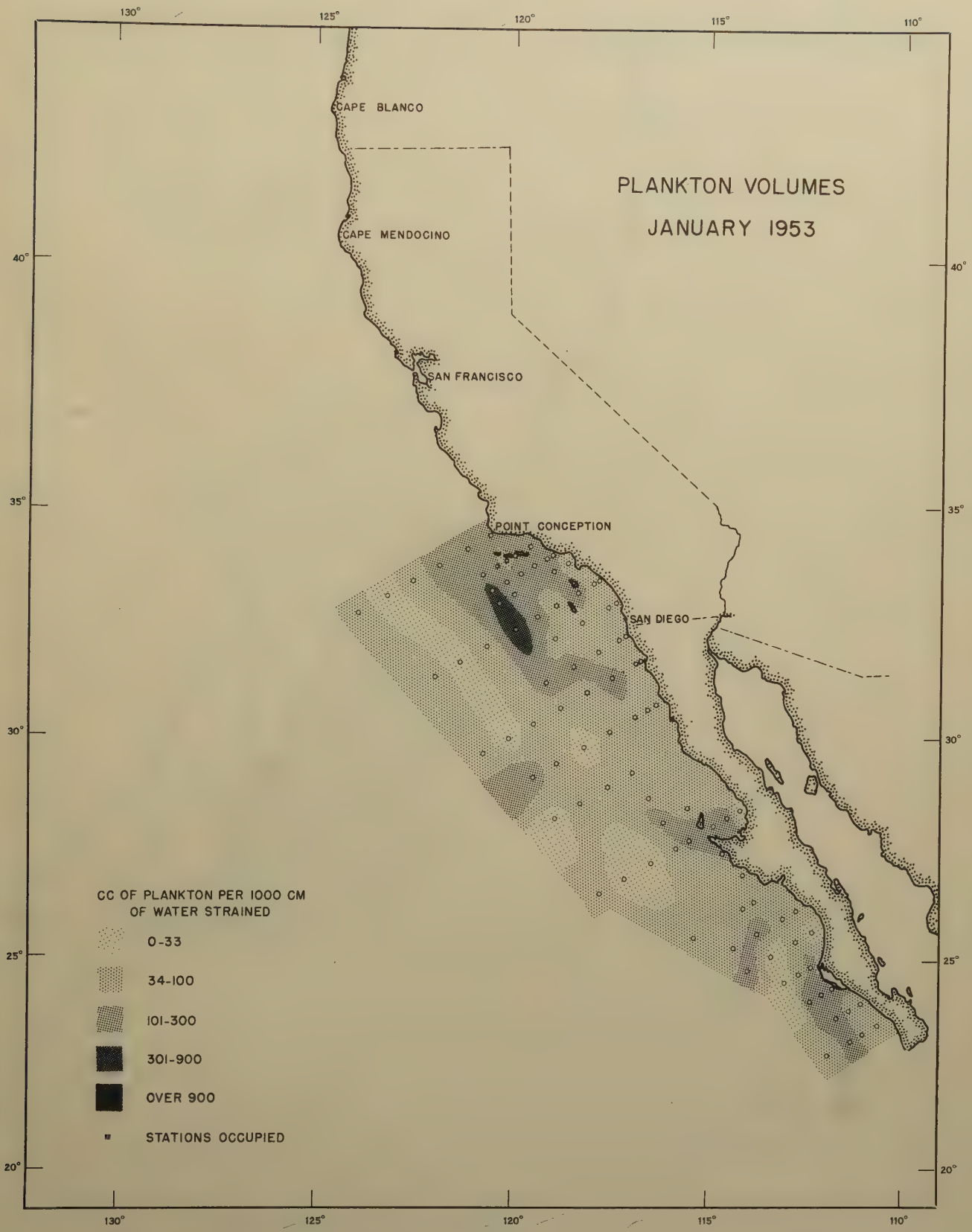
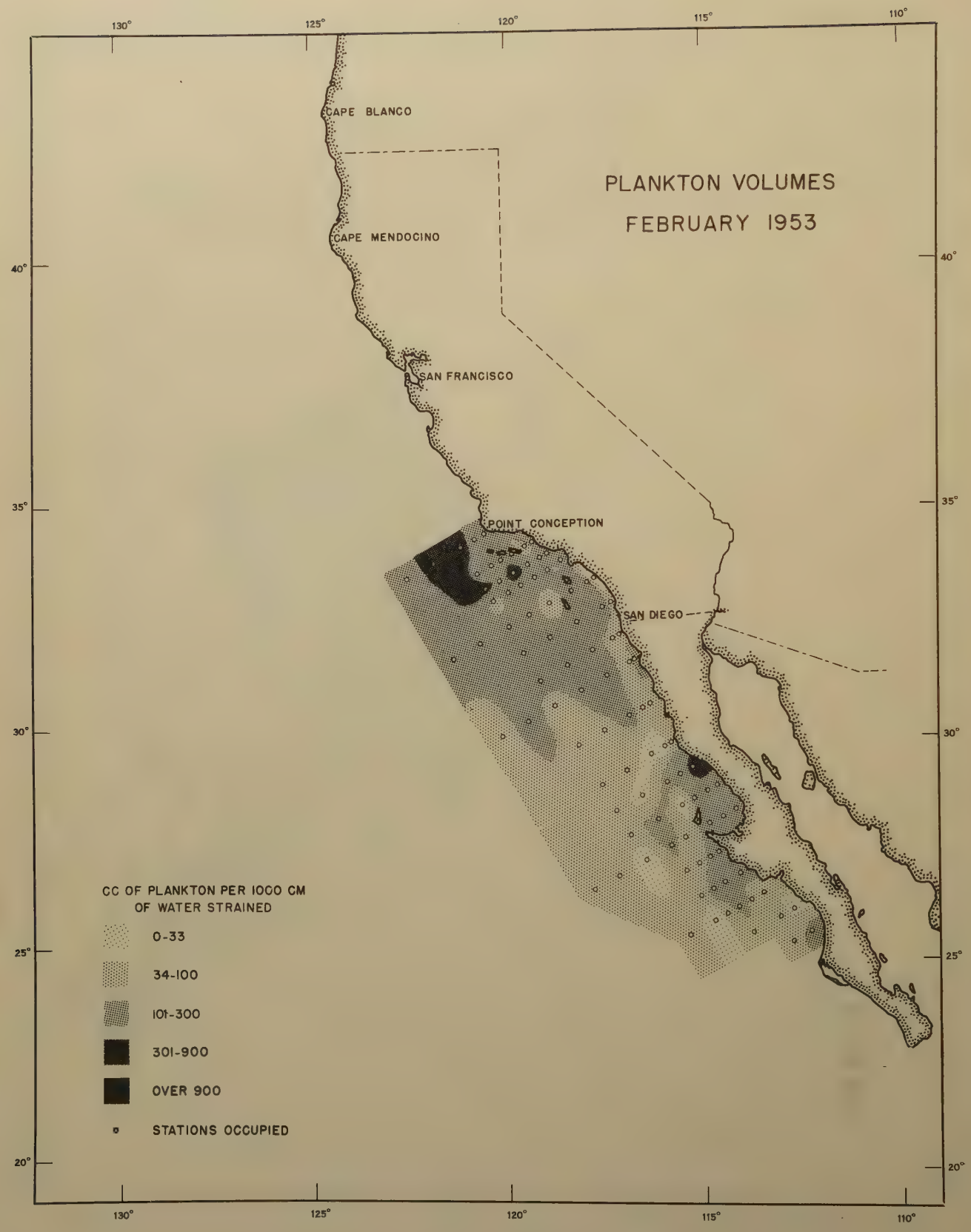
OVER 900
STATIONS OCCUPIED


AVERAGE PLANKTON VOLUMES
1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JANUARY 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
FEBRUARY 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
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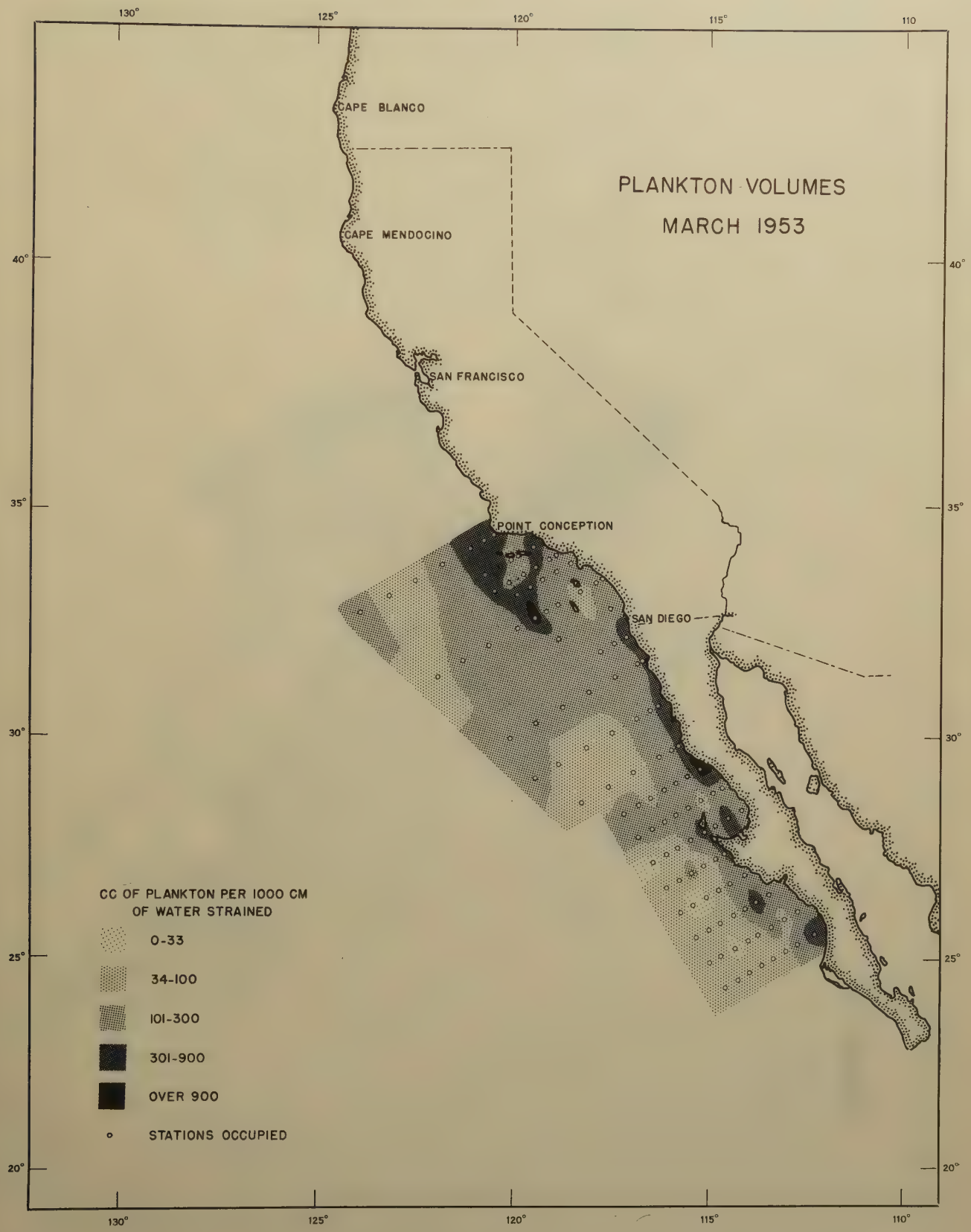
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MARCH 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110
40°
35°
30°
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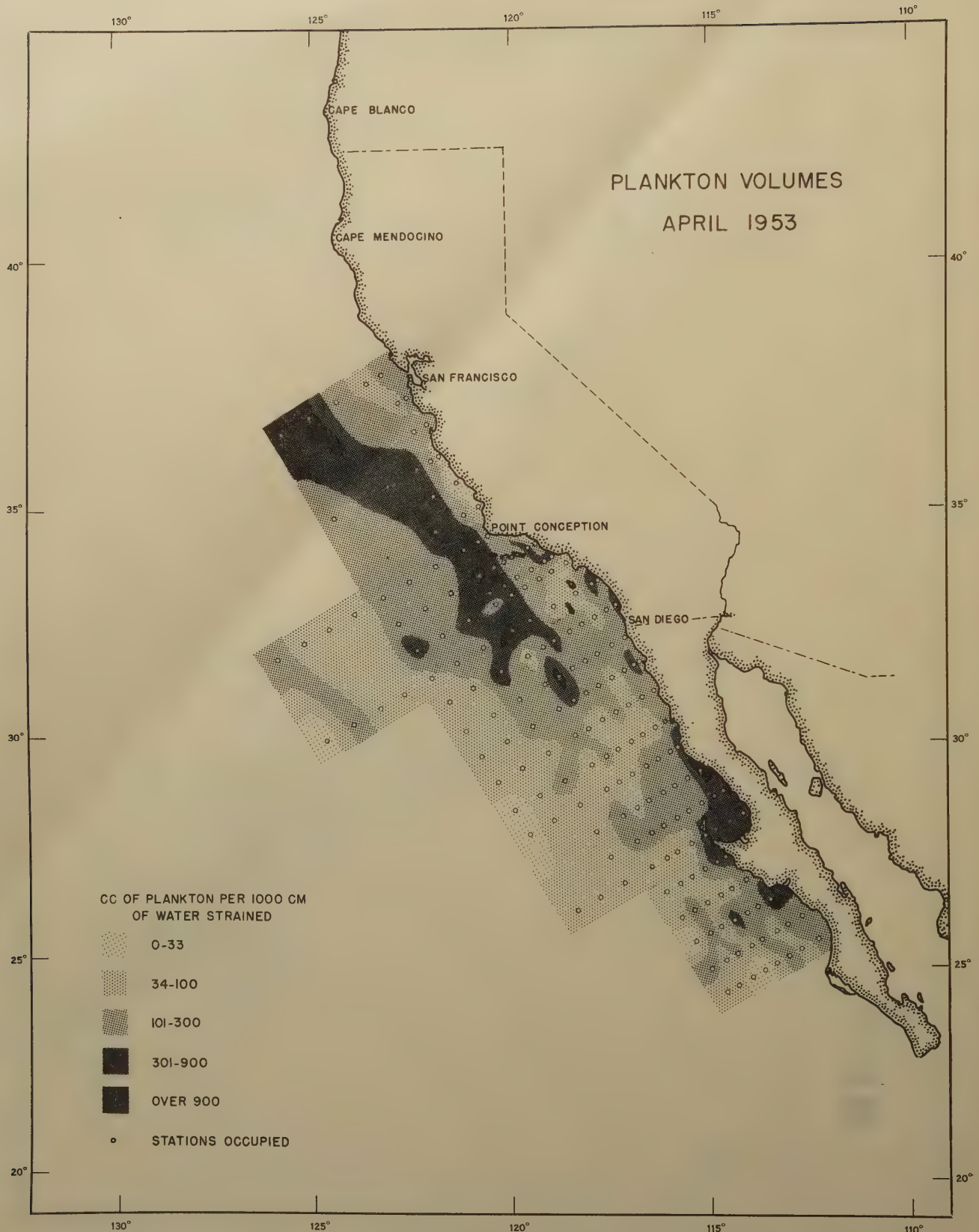
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
APRIL 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
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110°
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20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
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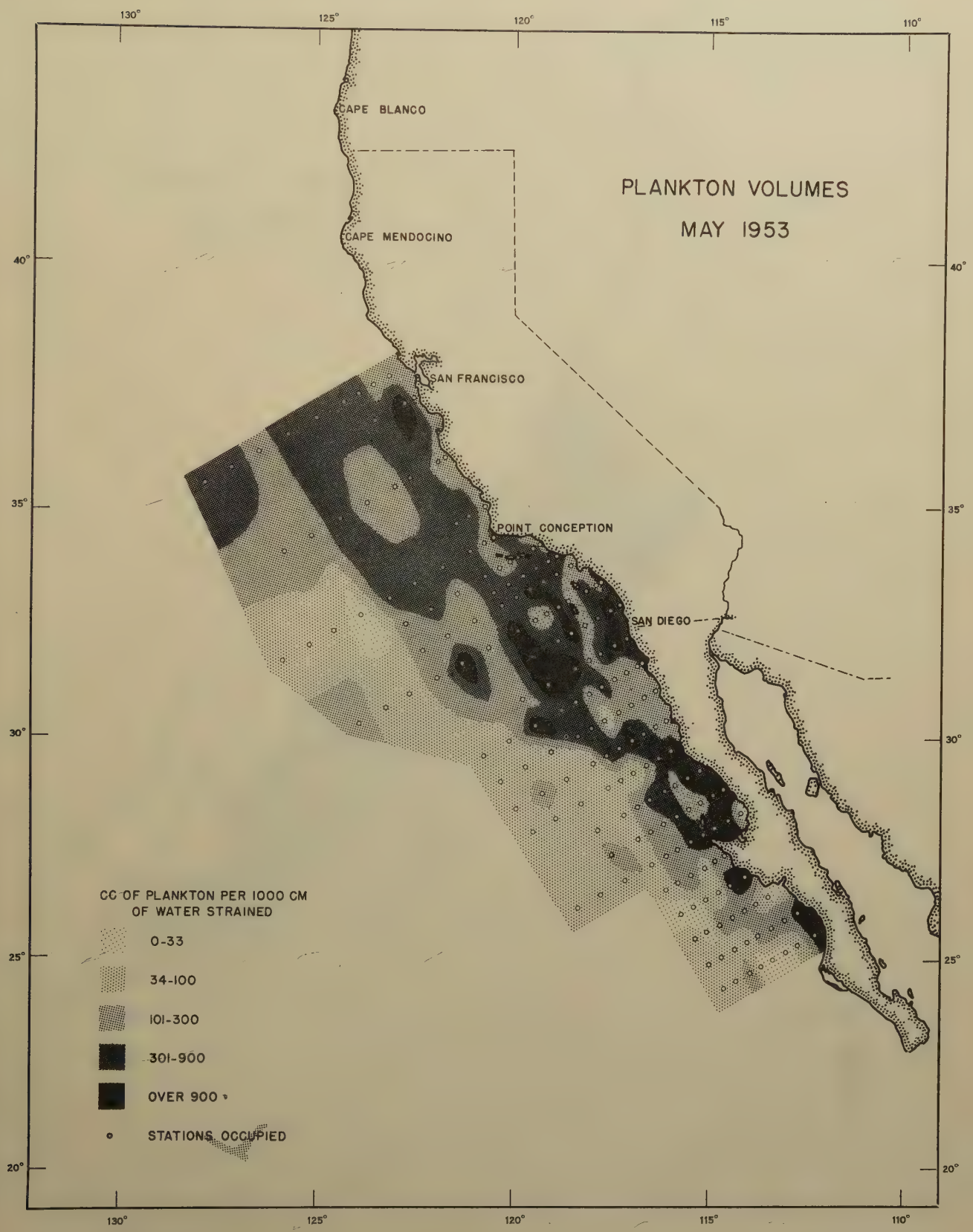
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MAY 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
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20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
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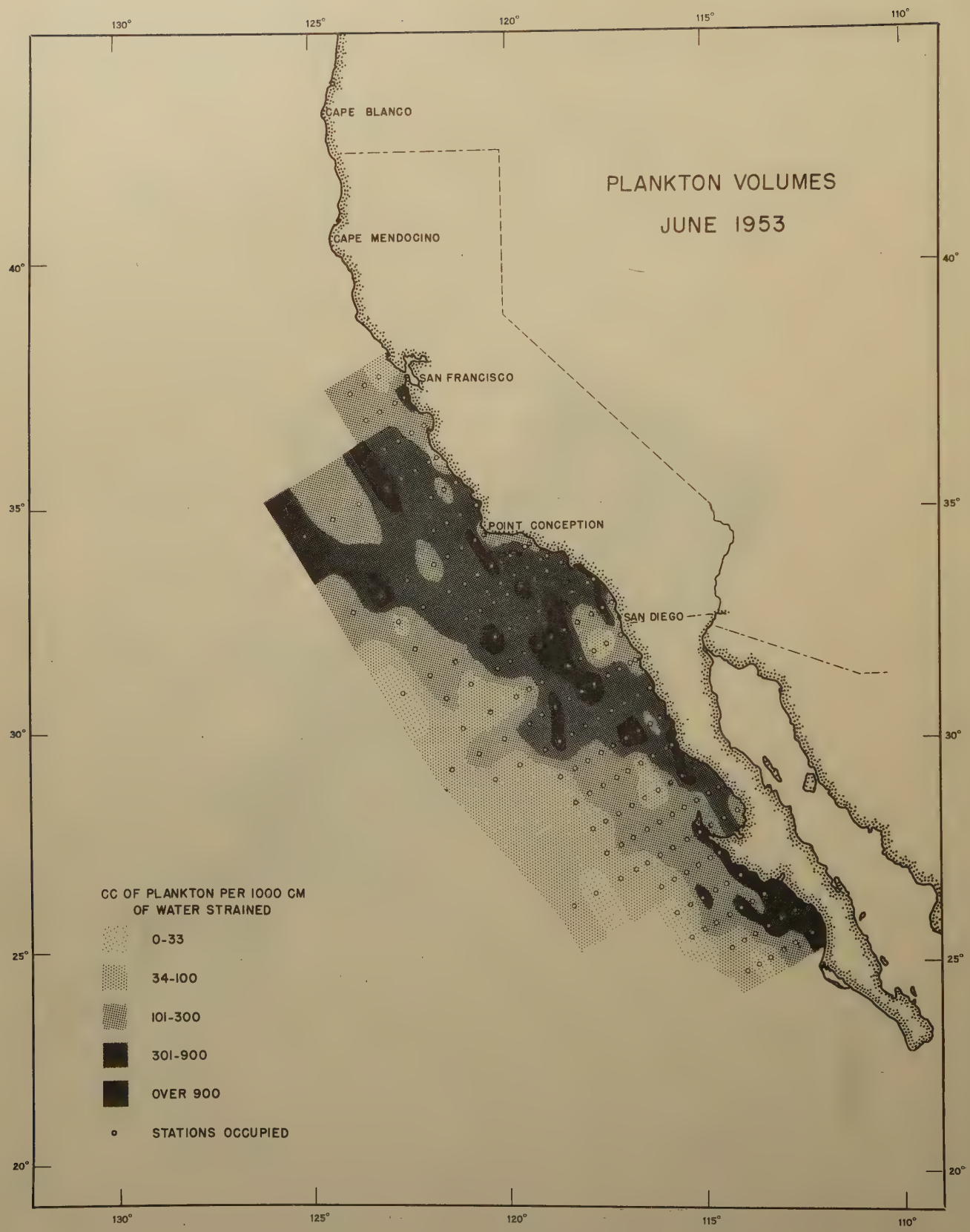
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JUNE 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
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110°
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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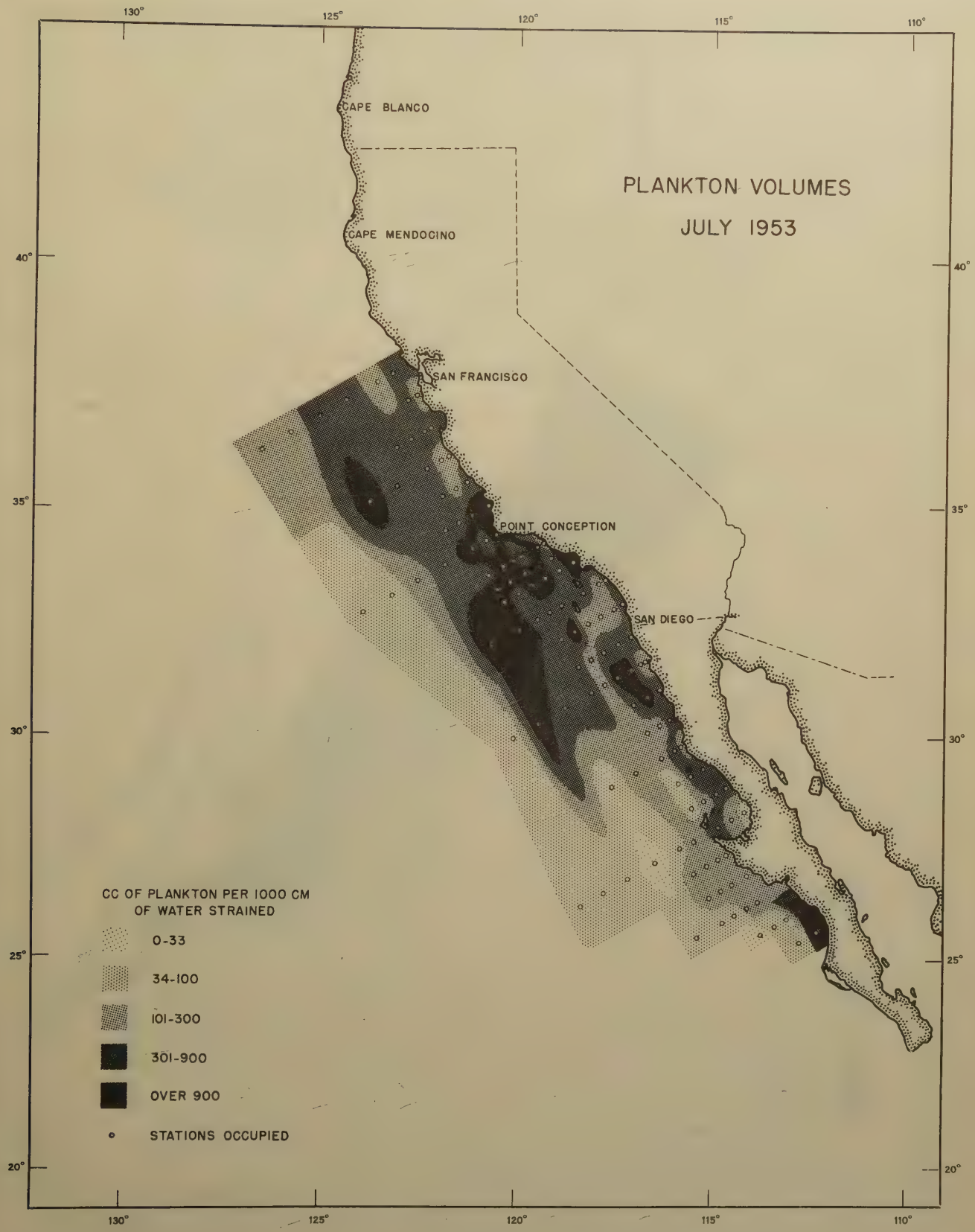
STATIONS OCCUPIED


PLANKTON VOLUMES
JULY 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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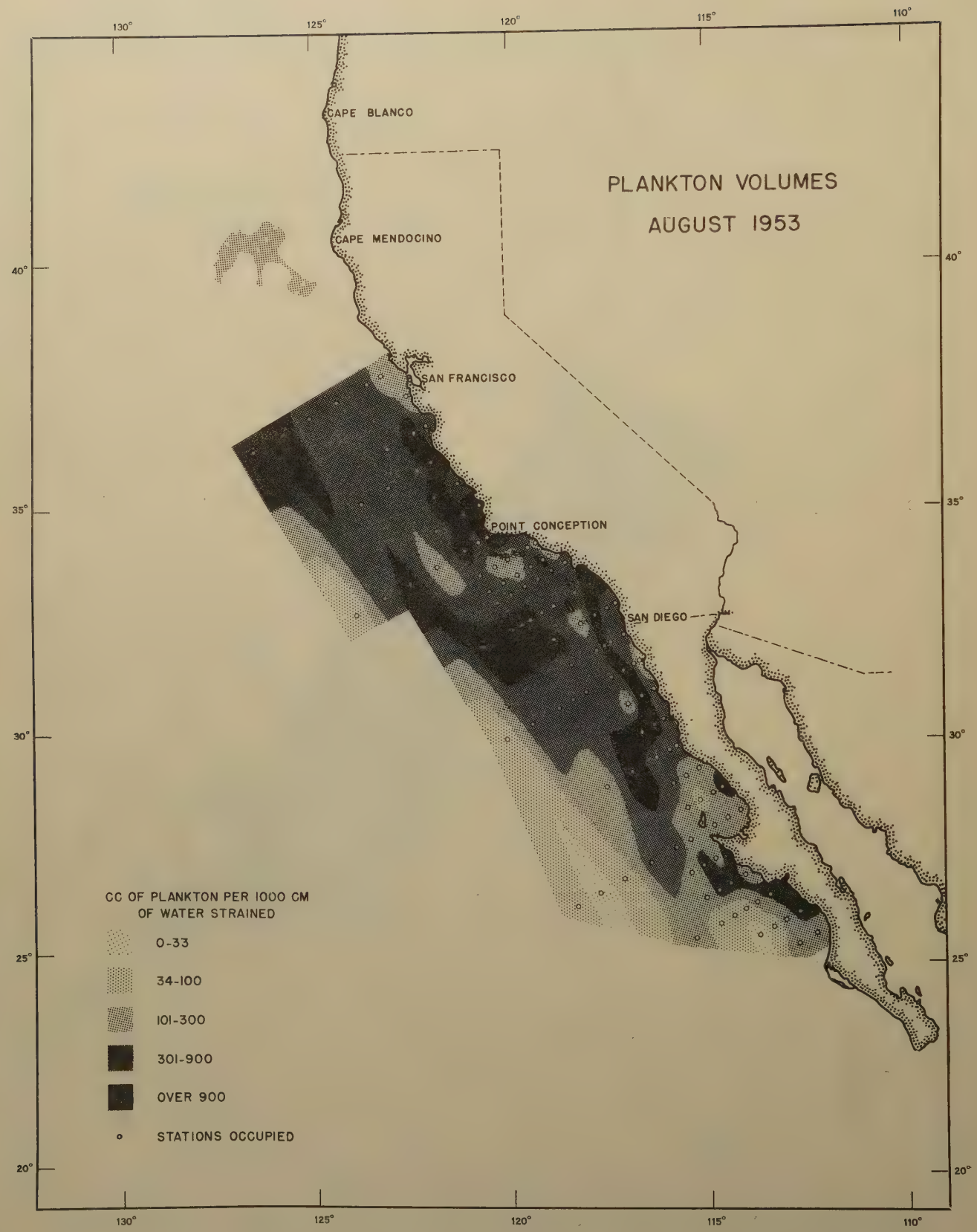
STATIONS OCCUPIED


PLANKTON VOLUMES
AUGUST 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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110°
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CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
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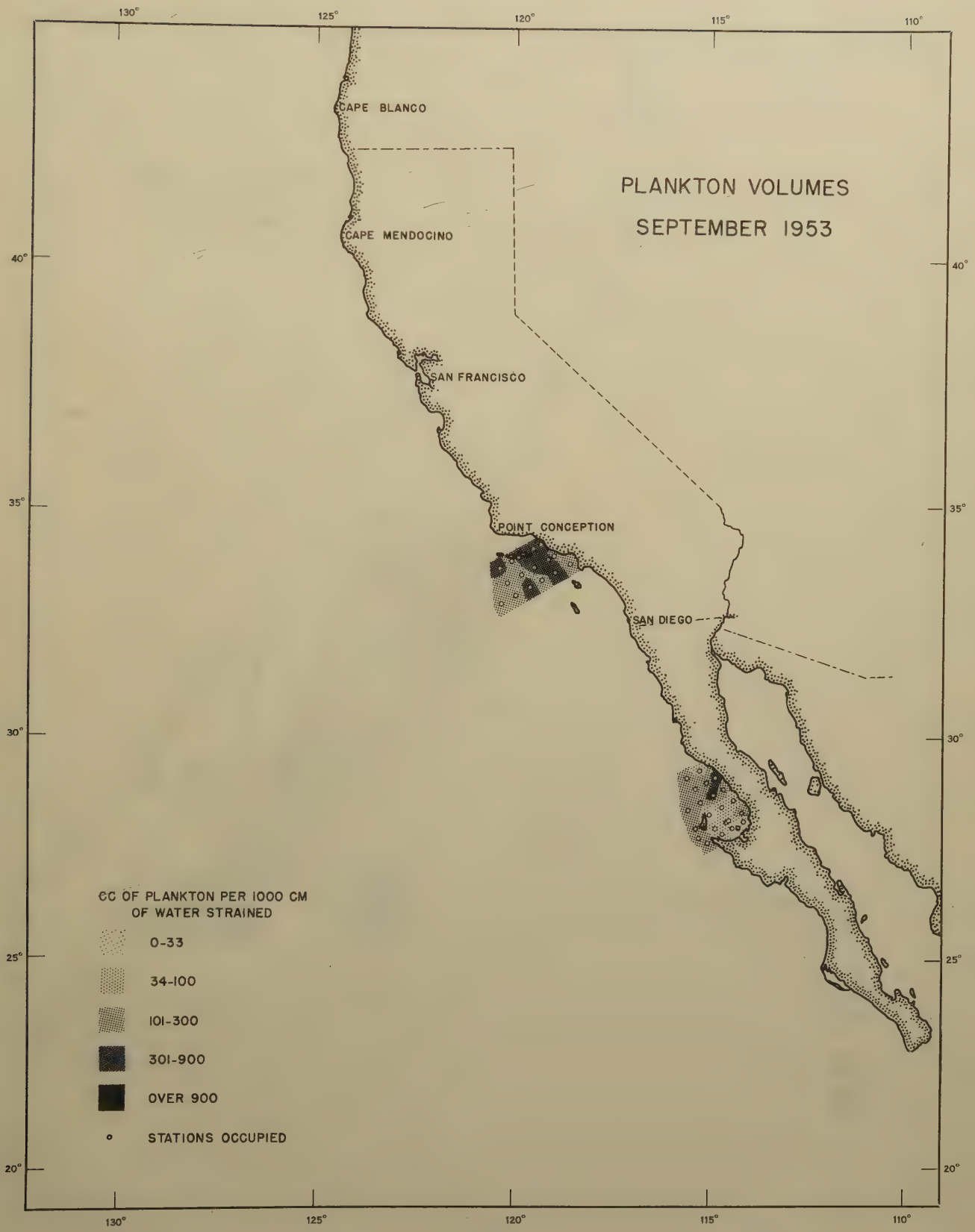
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
SEPTEMBER 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
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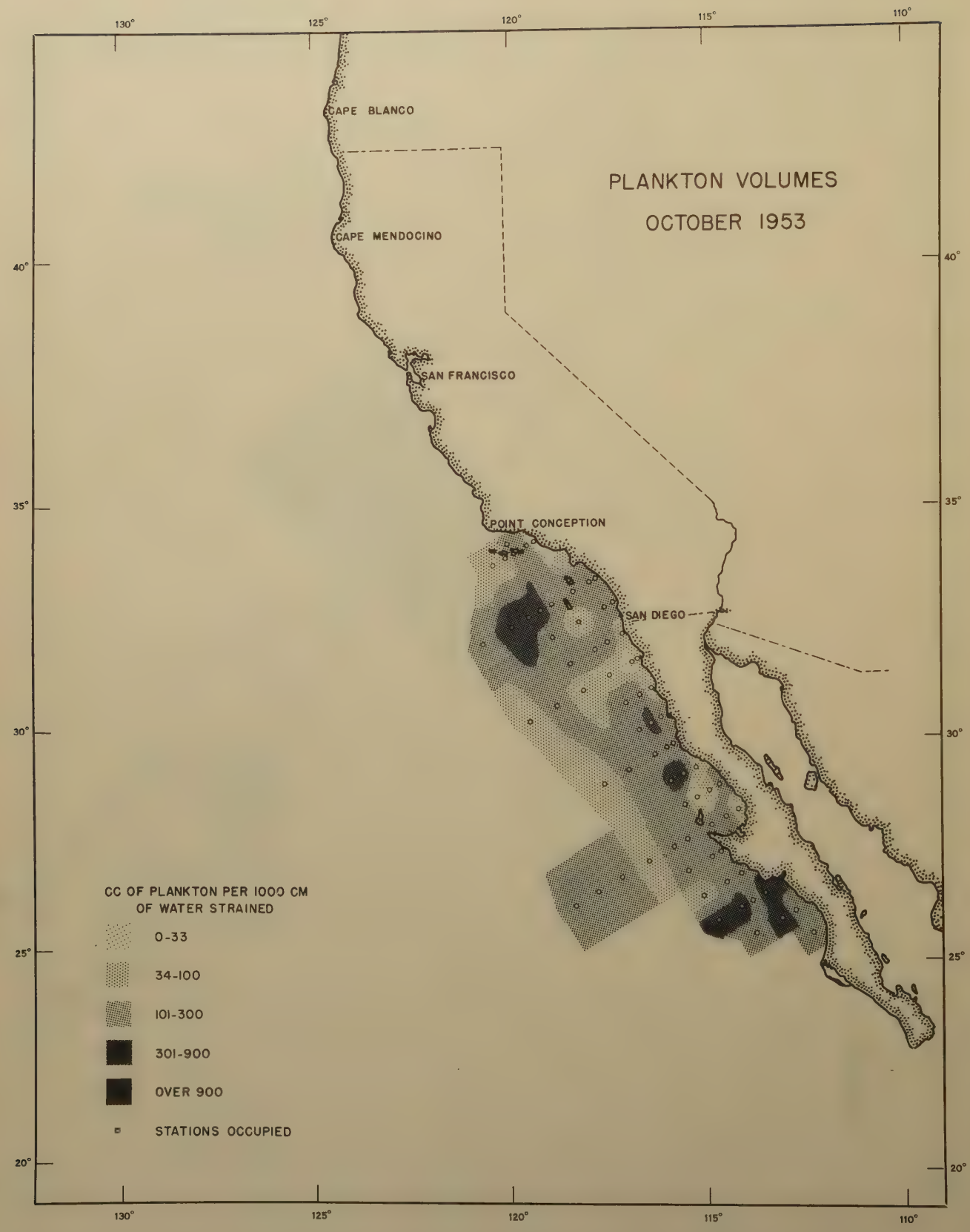
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
OCTOBER 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
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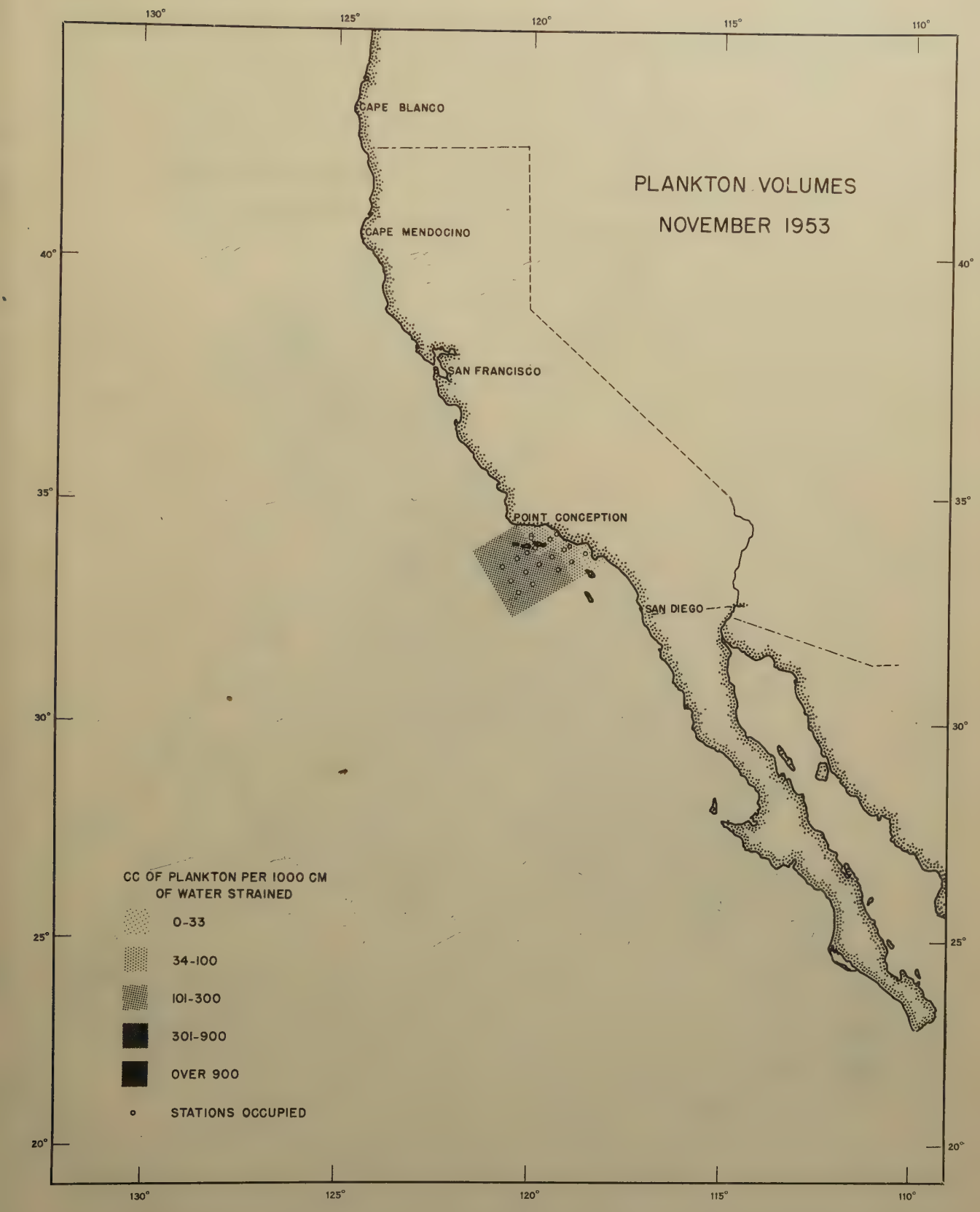
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
NOVEMBER 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
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125°
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110°
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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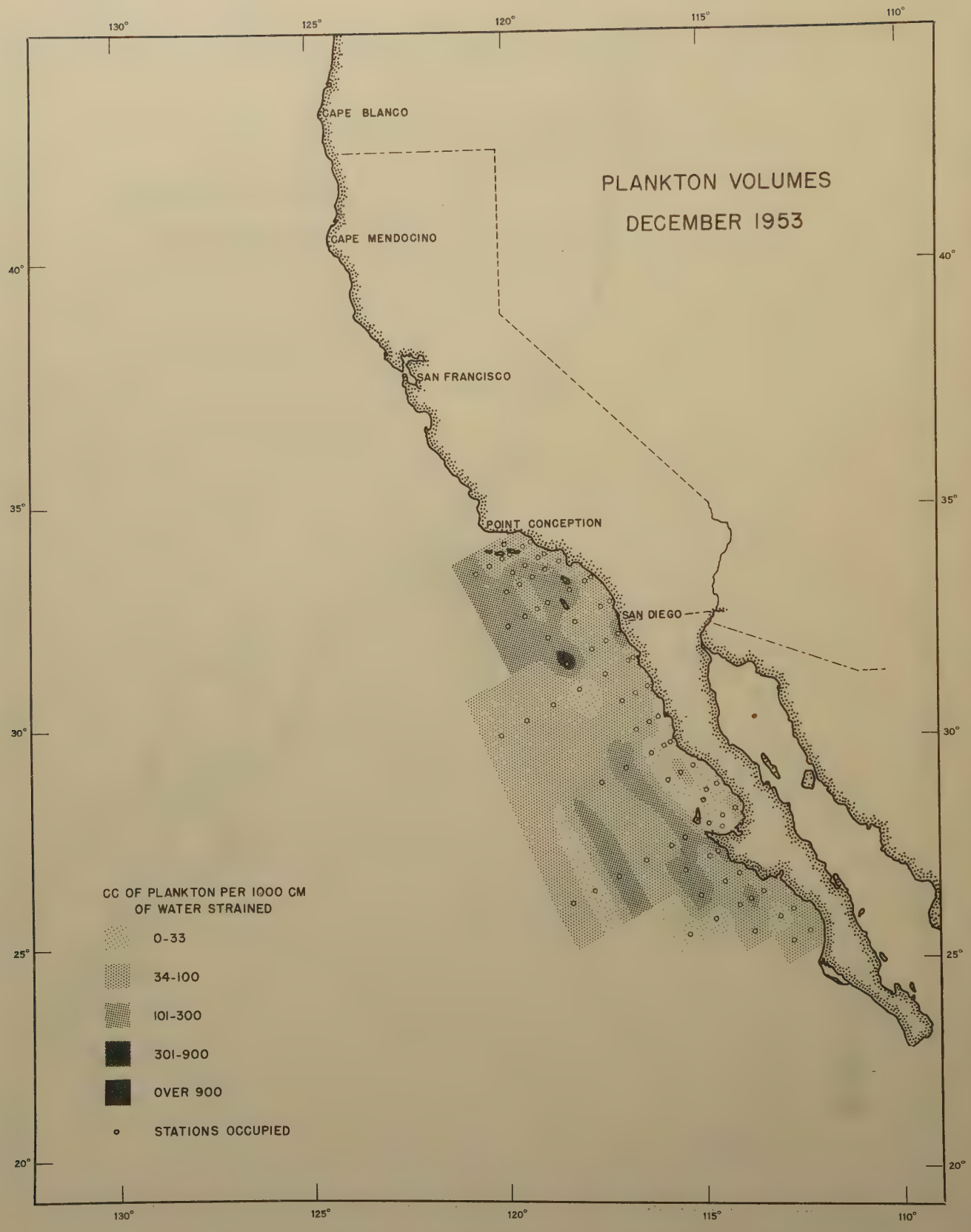
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
DECEMBER 1953
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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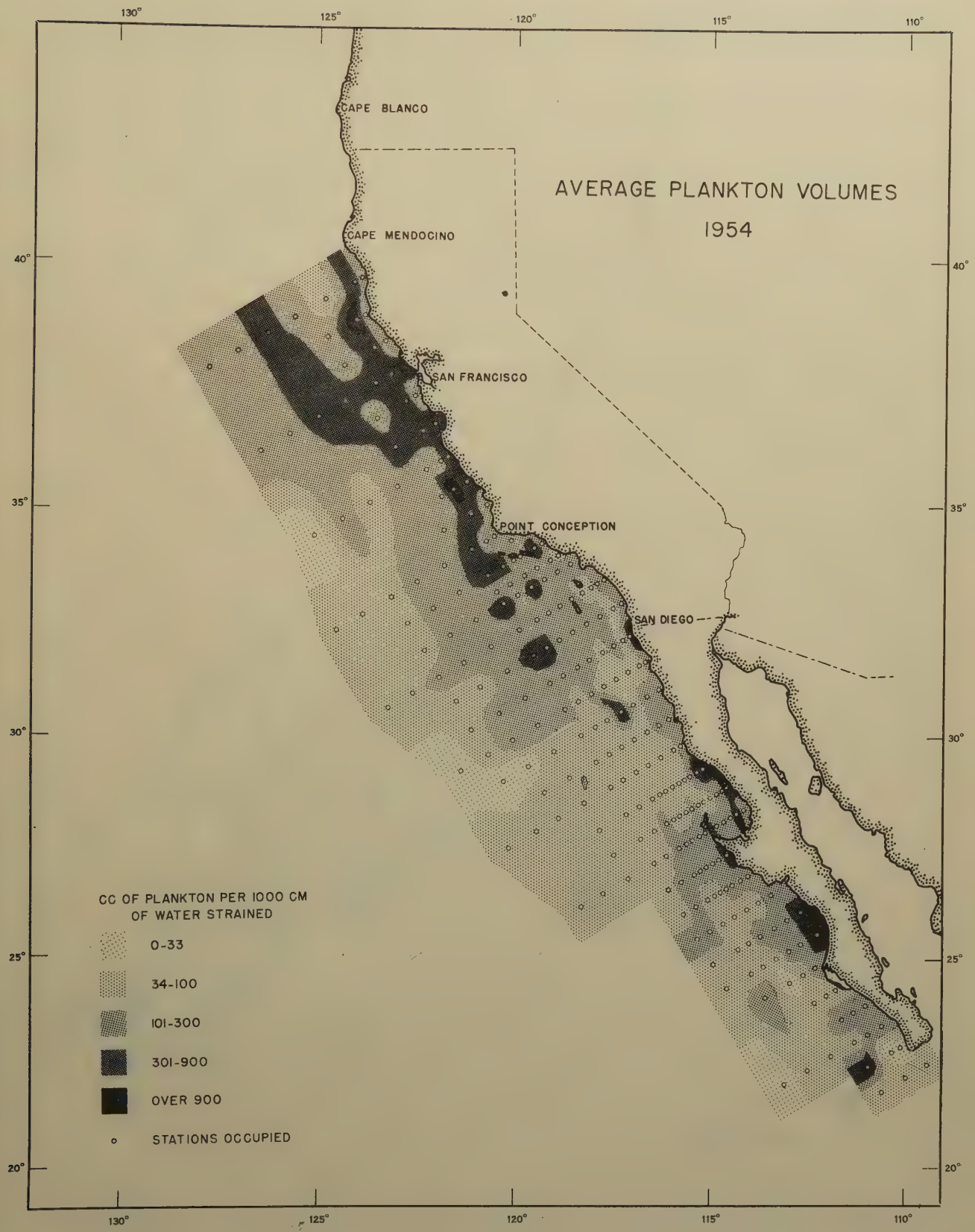
OVER 900
STATIONS OCCUPIED


AVERAGE PLANKTON VOLUMES
1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
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CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
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34-100
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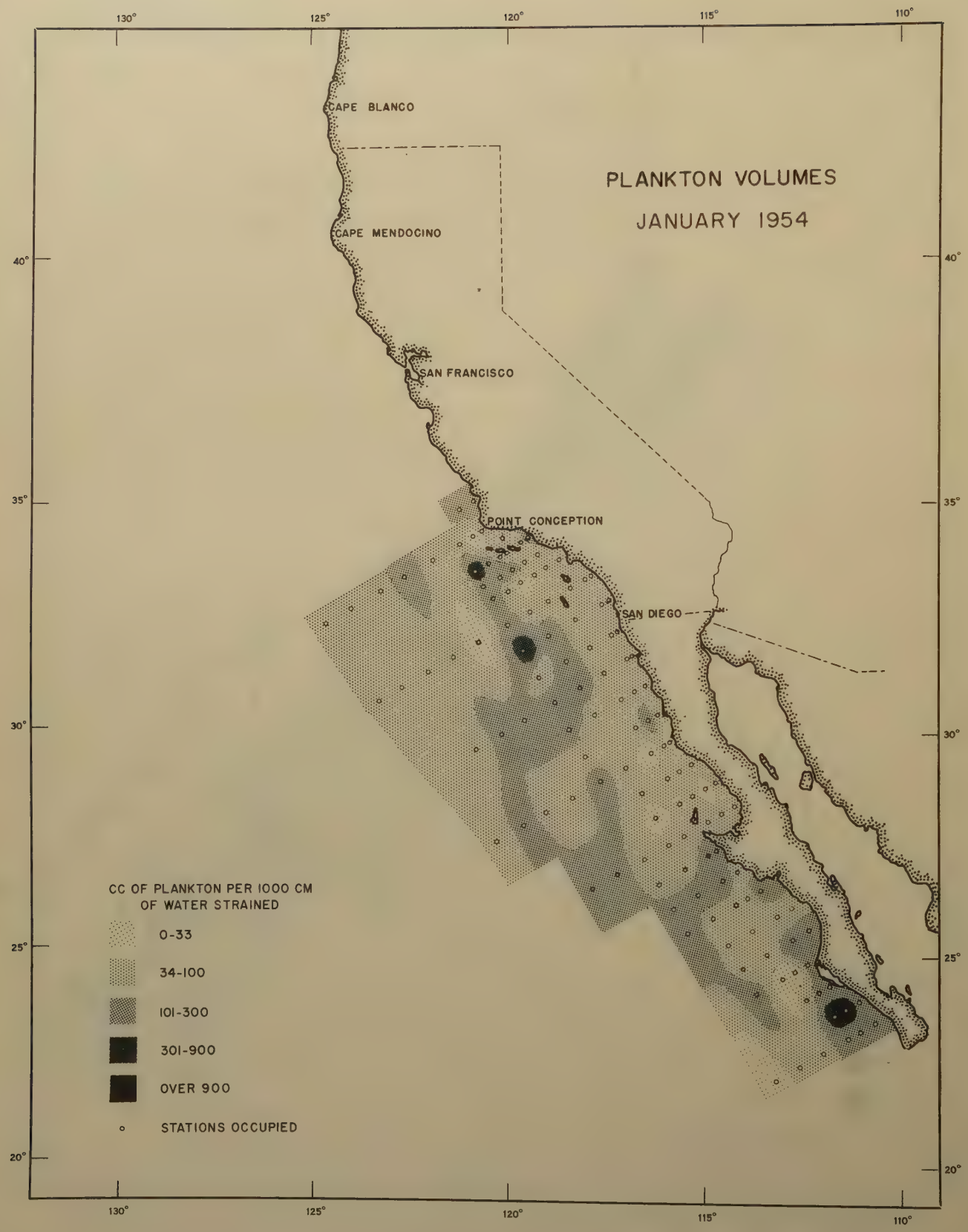
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JANUARY 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
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110°
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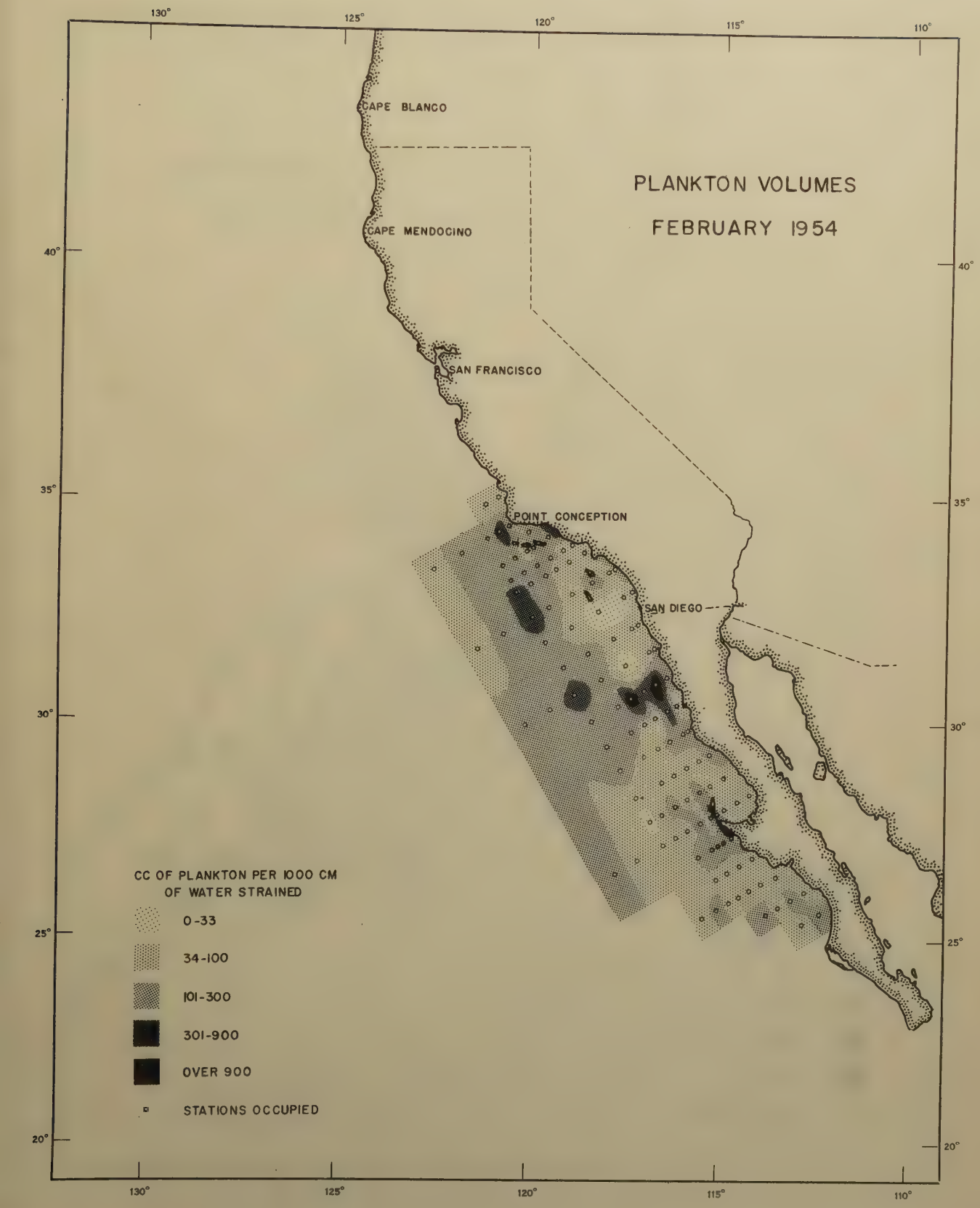
PLANKTON VOLUMES
FEBRUARY 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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115°
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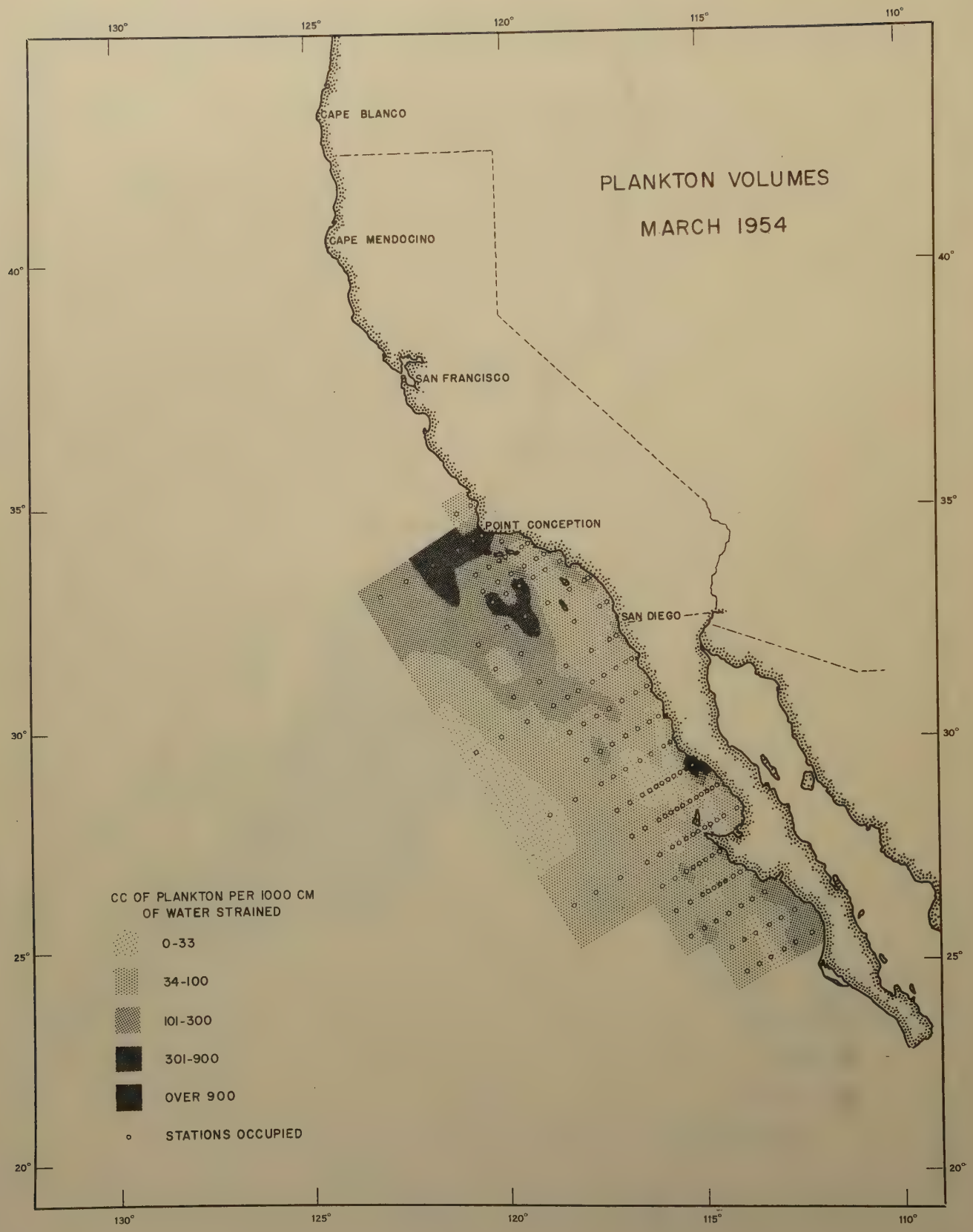
PLANKTON VOLUMES
MARCH 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
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125°
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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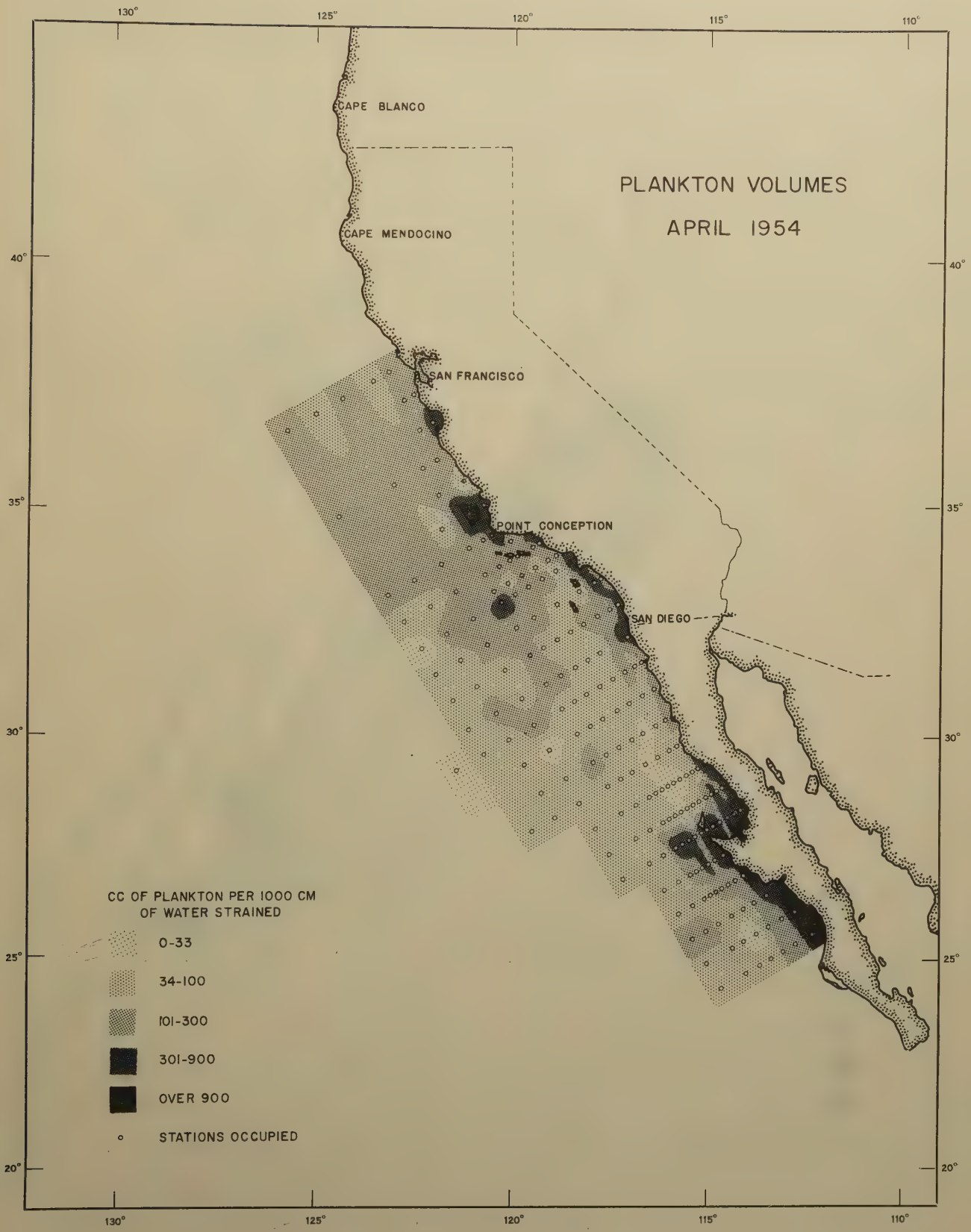
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
APRIL 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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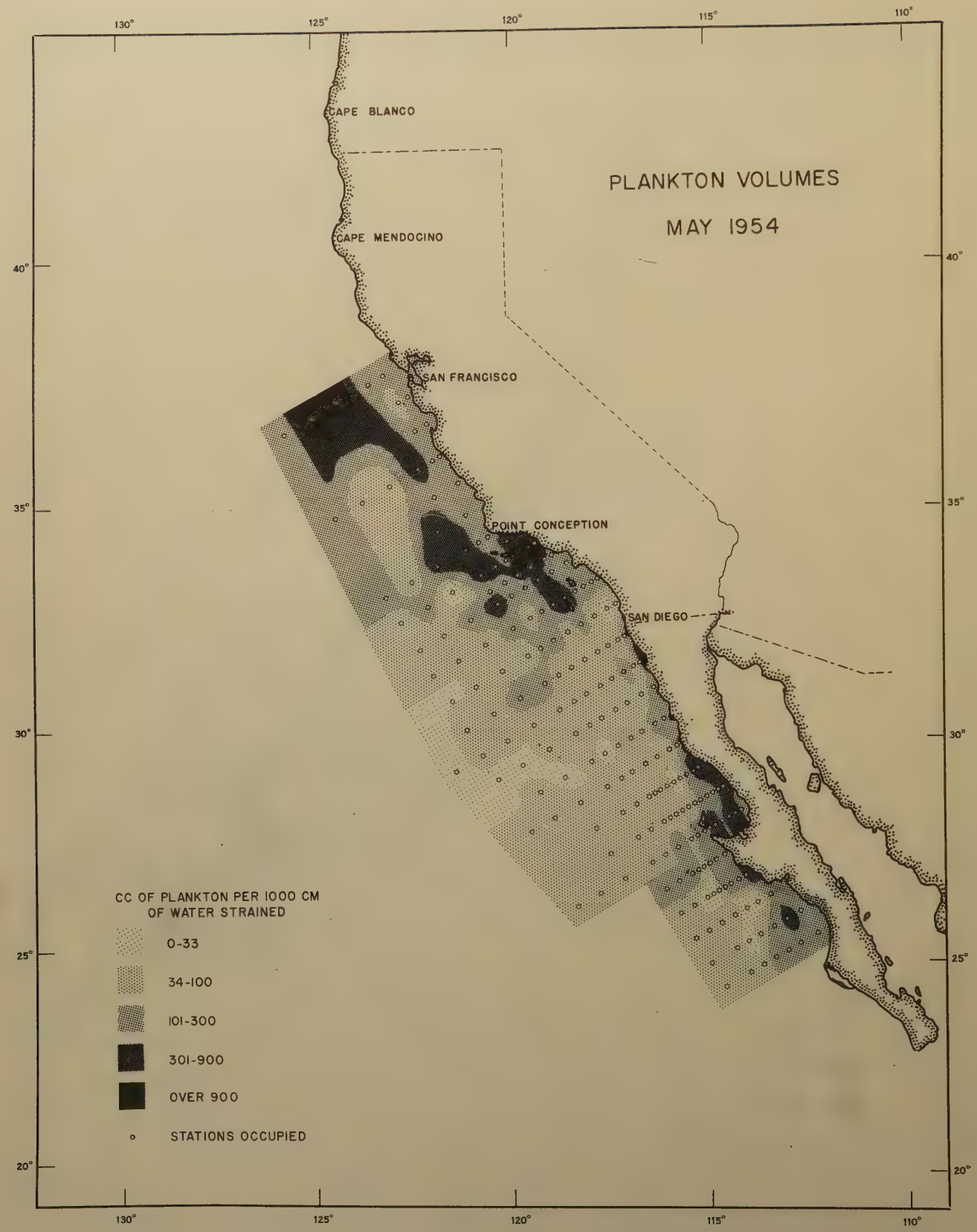
STATIONS OCCUPIED


PLANKTON VOLUMES
MAY 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
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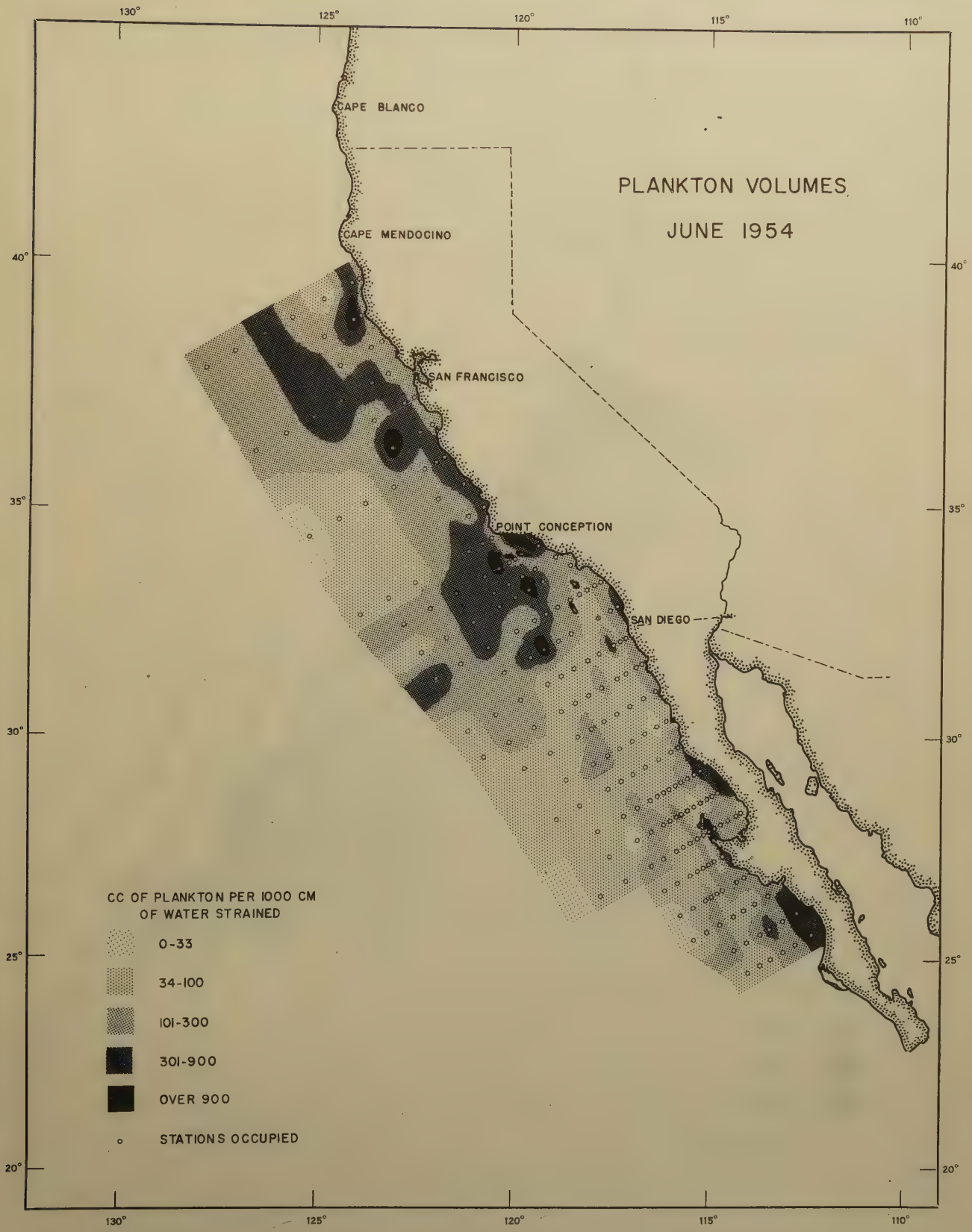
PLANKTON VOLUMES
JUNE 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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CC OF PLANKTON PER 1000 CM OF WATER STRAINED
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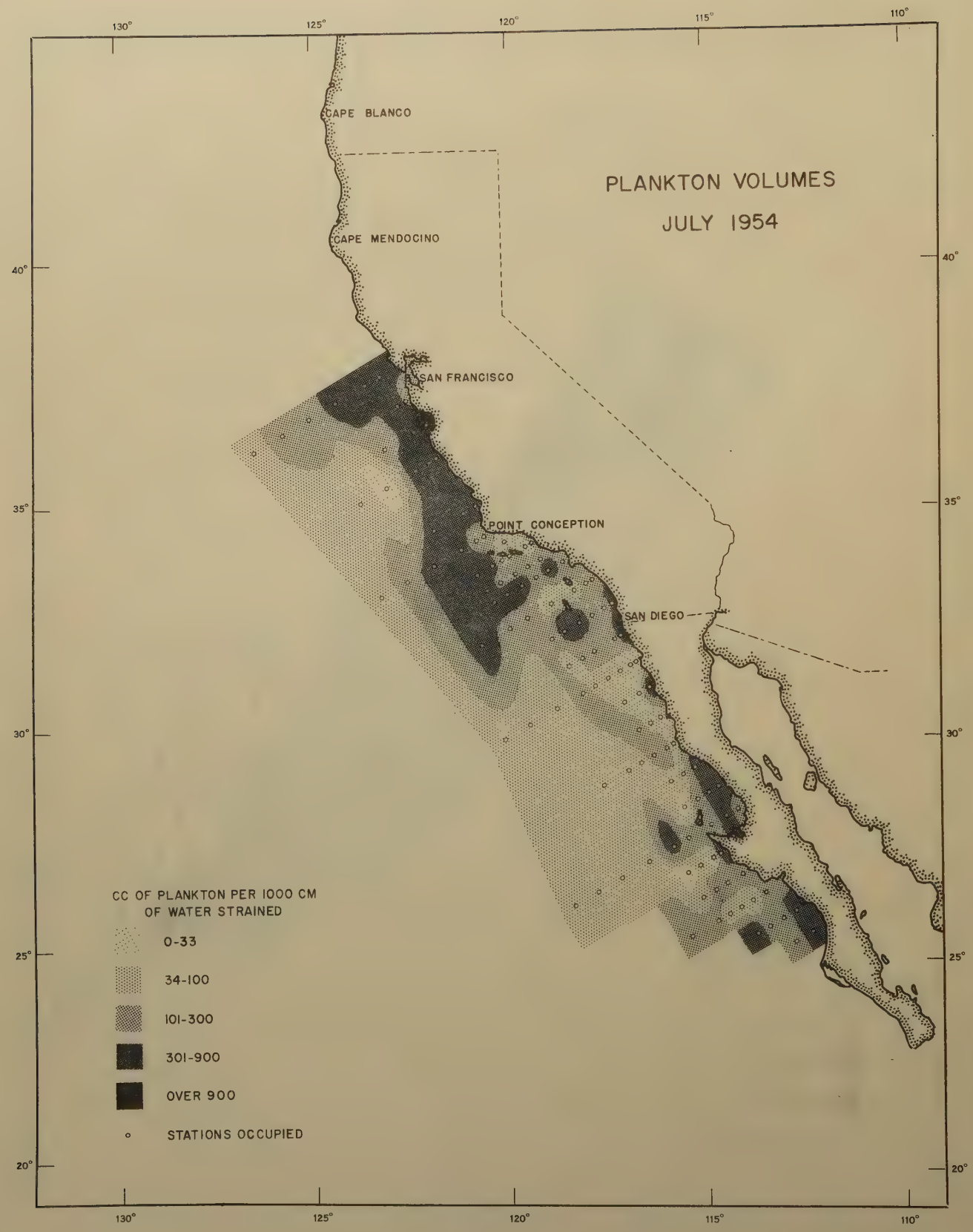
PLANKTON VOLUMES
JULY 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
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CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
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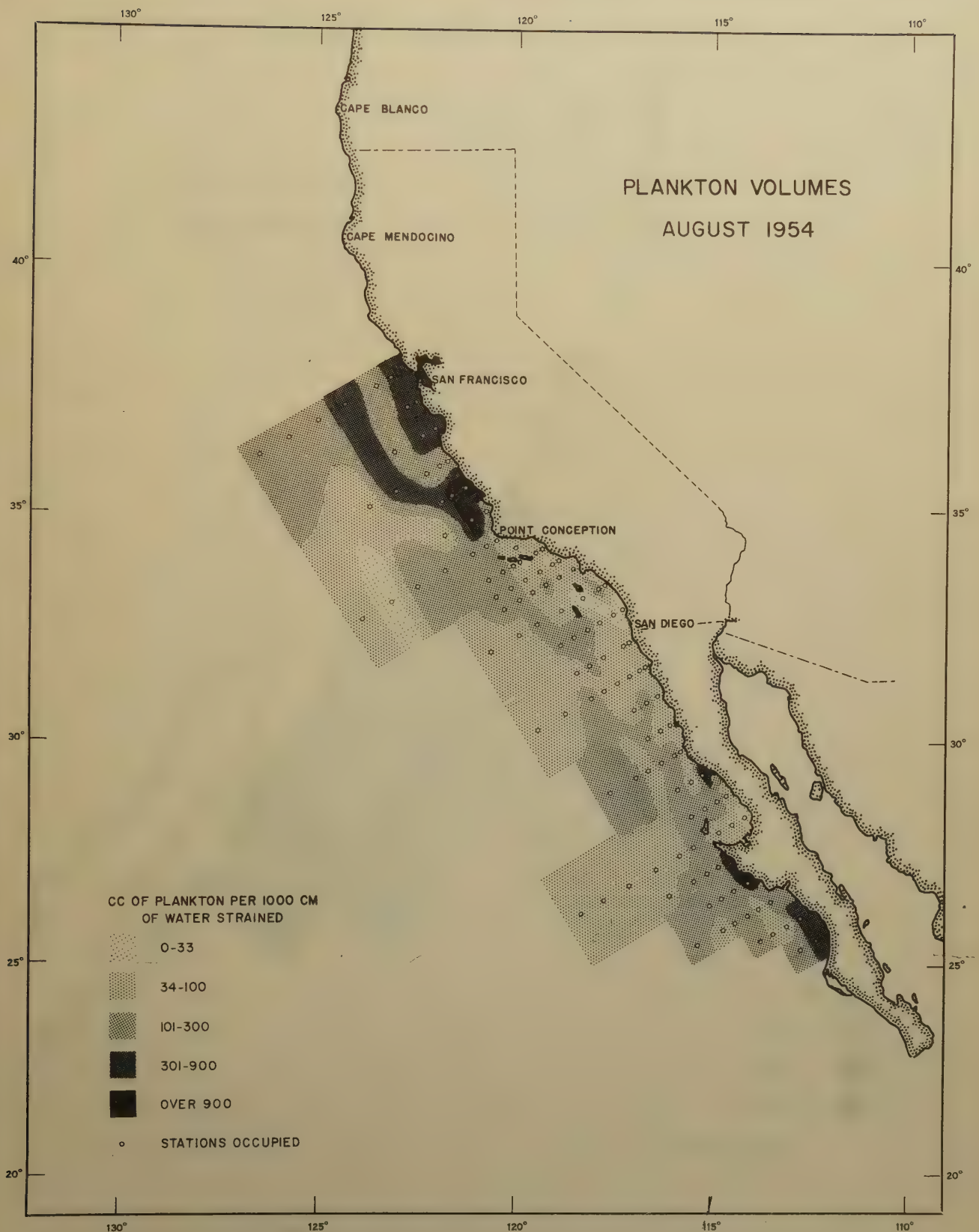
STATIONS OCCUPIED


PLANKTON VOLUMES
AUGUST 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
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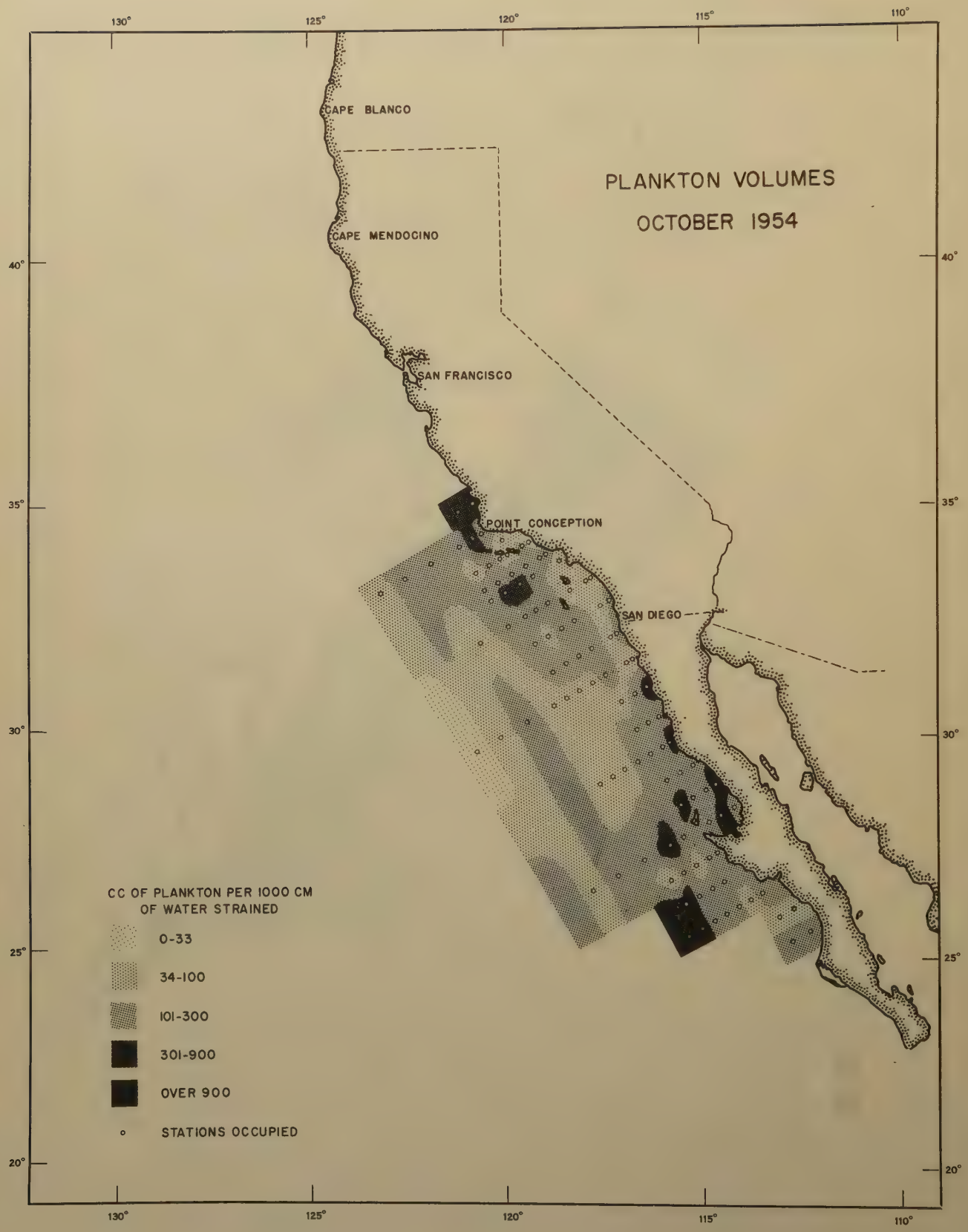
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
OCTOBER 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
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CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
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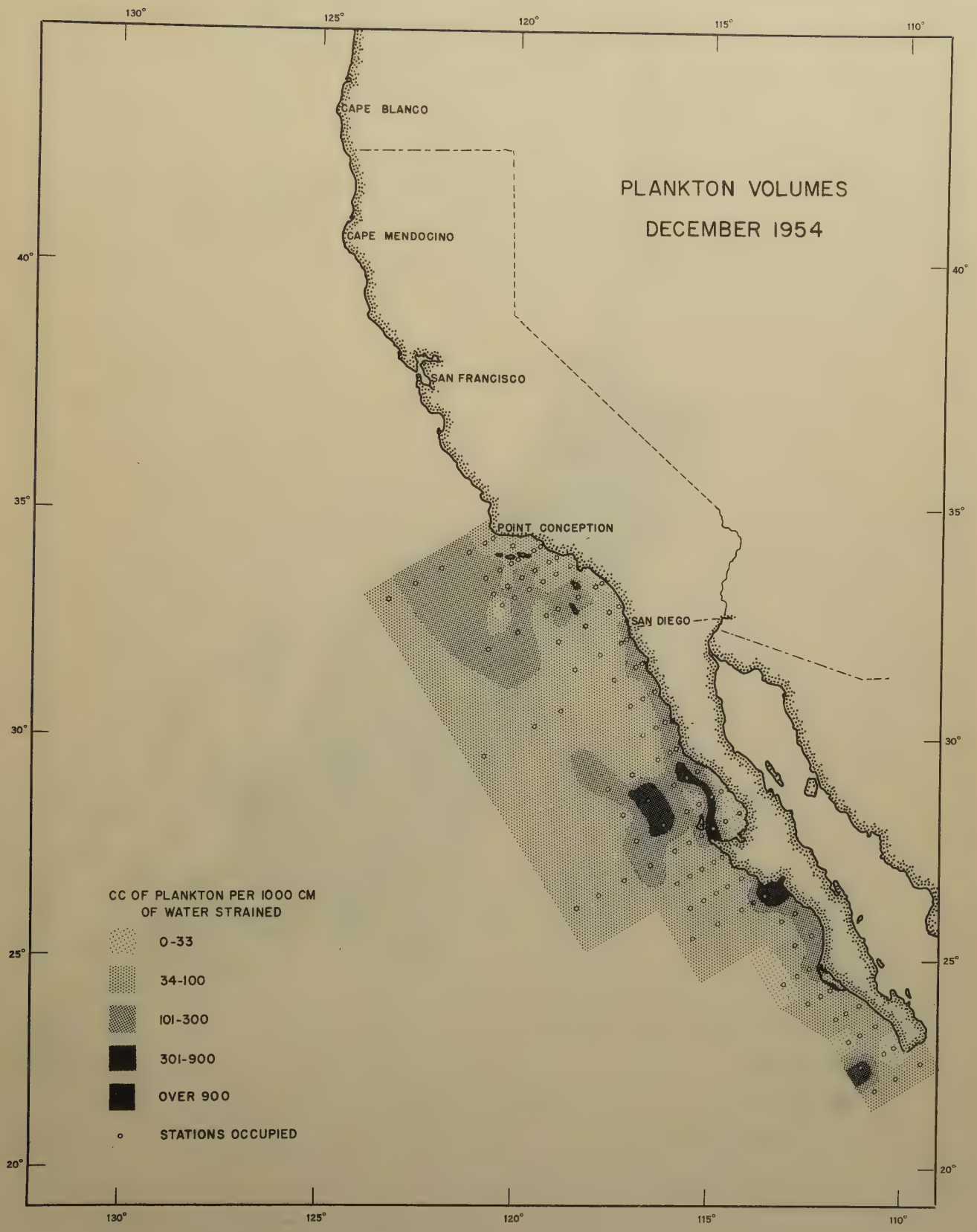
STATIONS OCCUPIED


PLANKTON VOLUMES
DECEMBER 1954
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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OF WATER STRAINED
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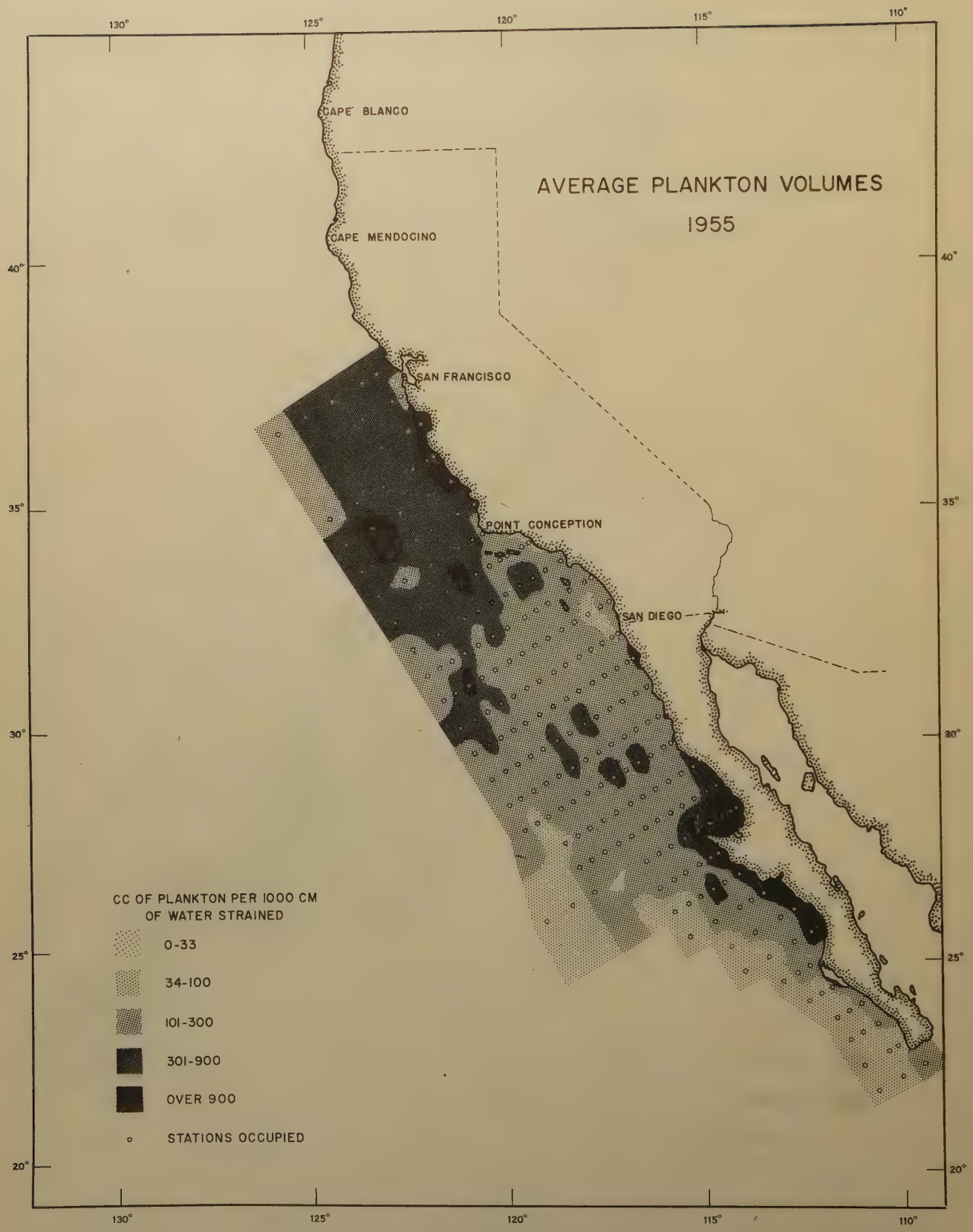
STATIONS OCCUPIED


AVERAGE PLANKTON VOLUMES
1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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115°
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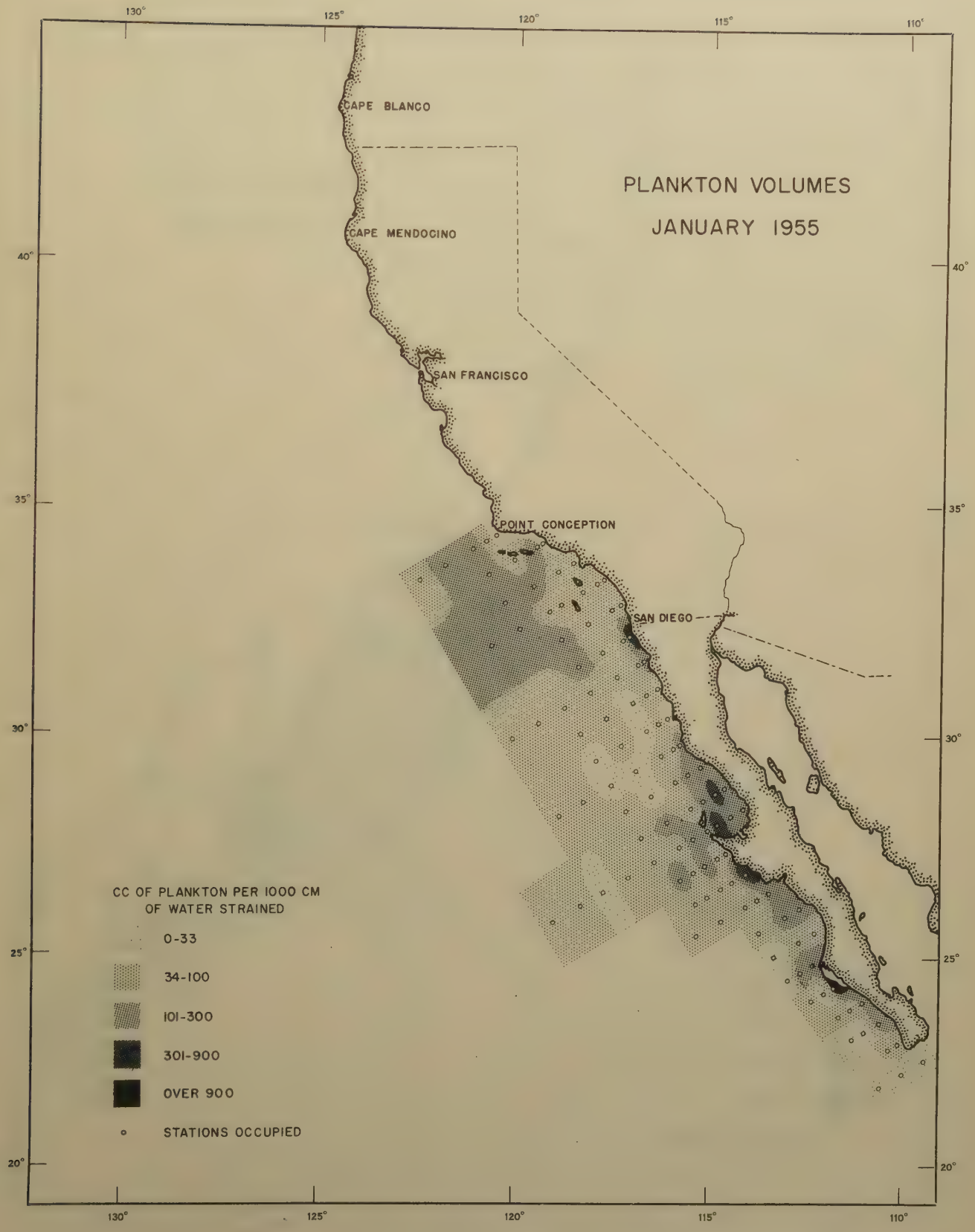
STATIONS OCCUPIED


PLANKTON VOLUMES
JANUARY 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
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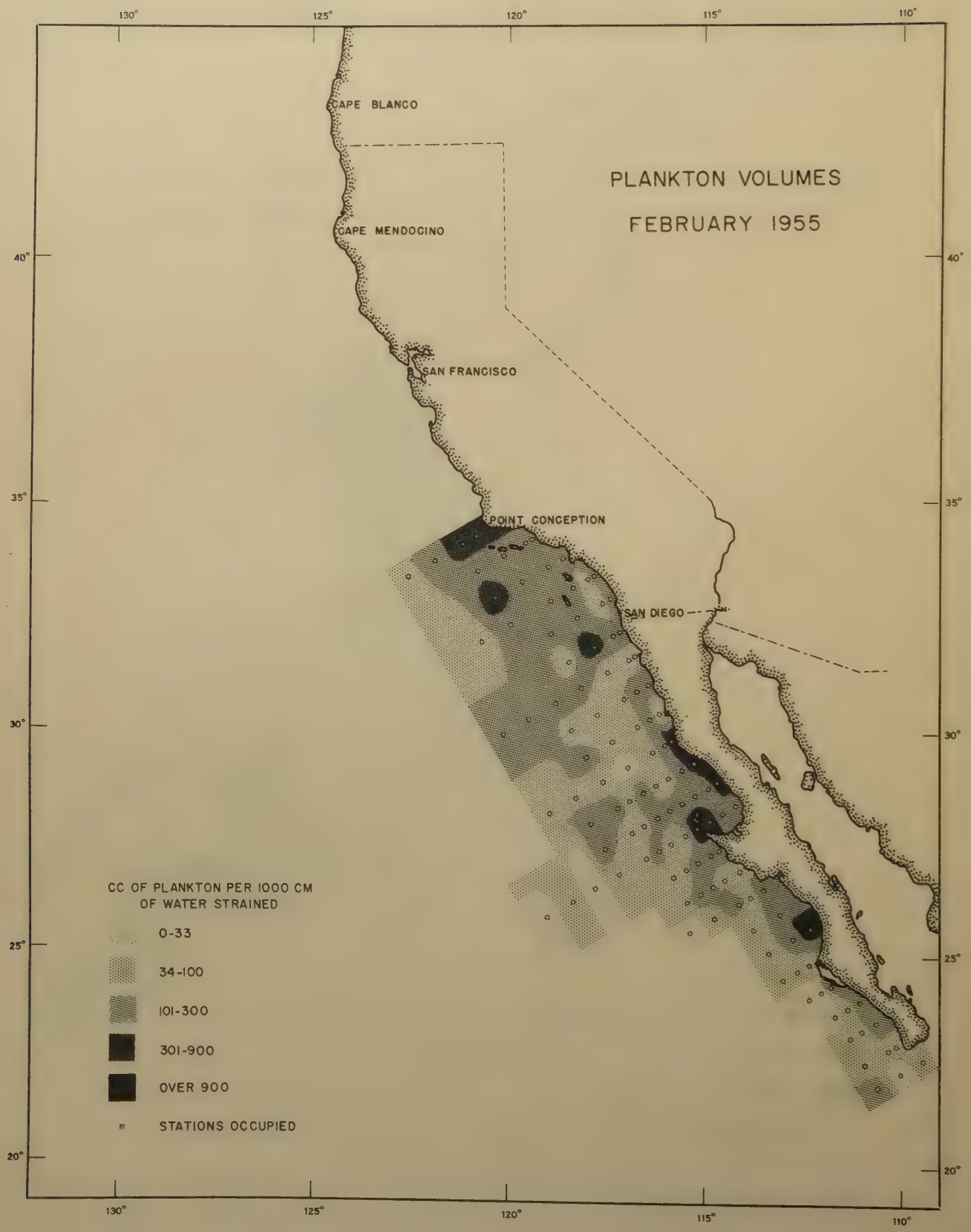
STATIONS OCCUPIED


PLANKTON VOLUMES
FEBRUARY 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
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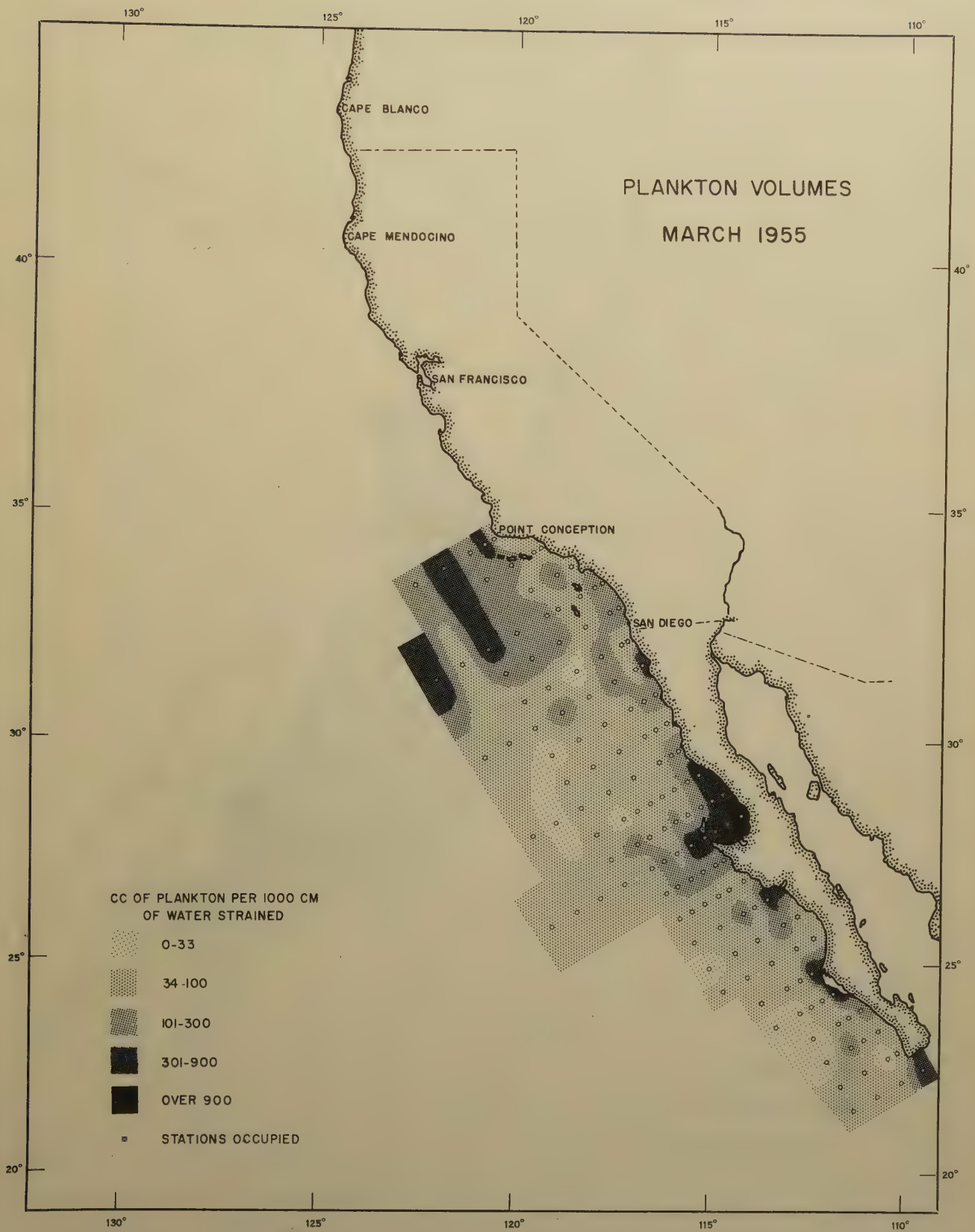
STATIONS OCCUPIED


PLANKTON VOLUMES
MARCH 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
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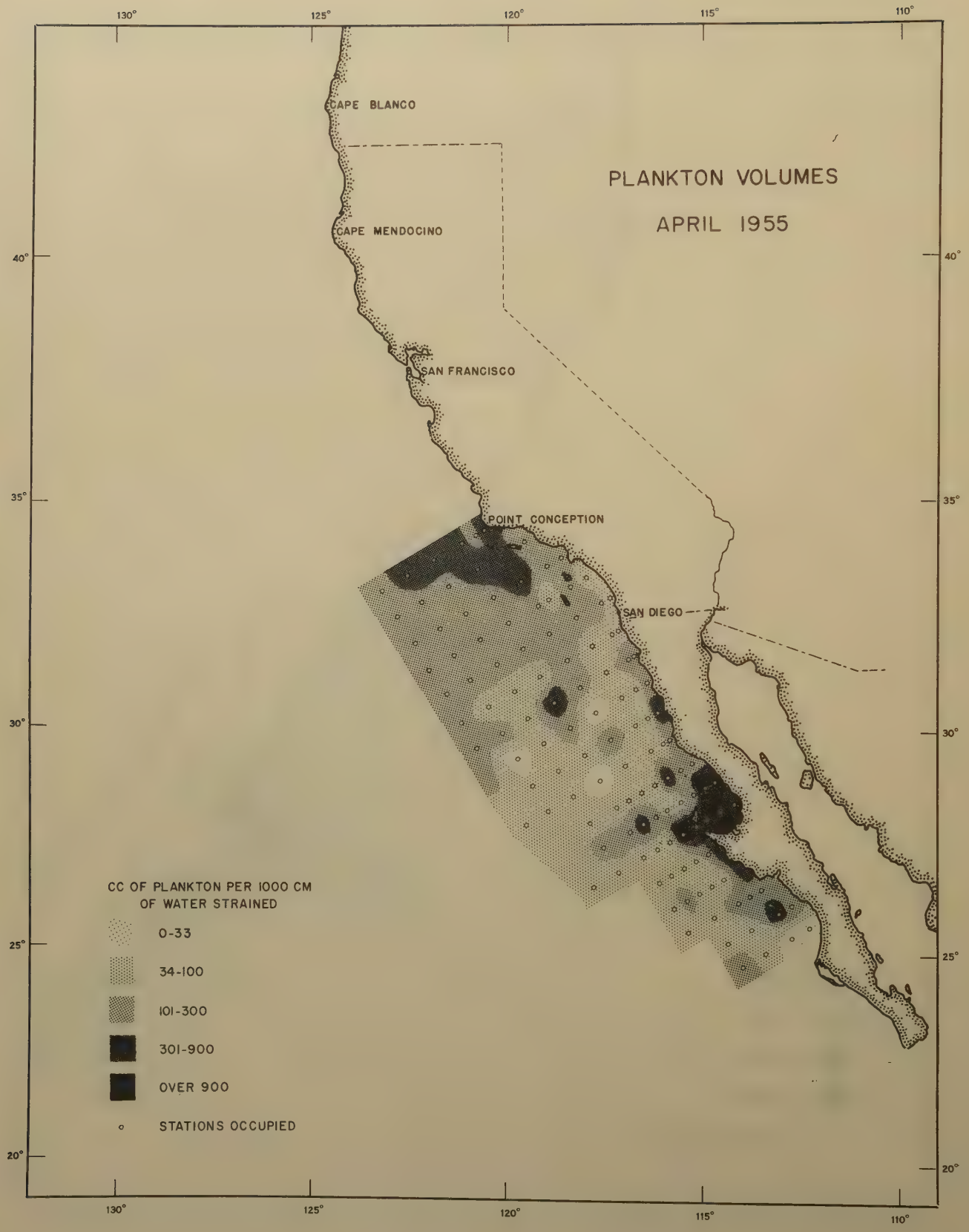
STATIONS OCCUPIED


PLANKTON VOLUMES
APRIL 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
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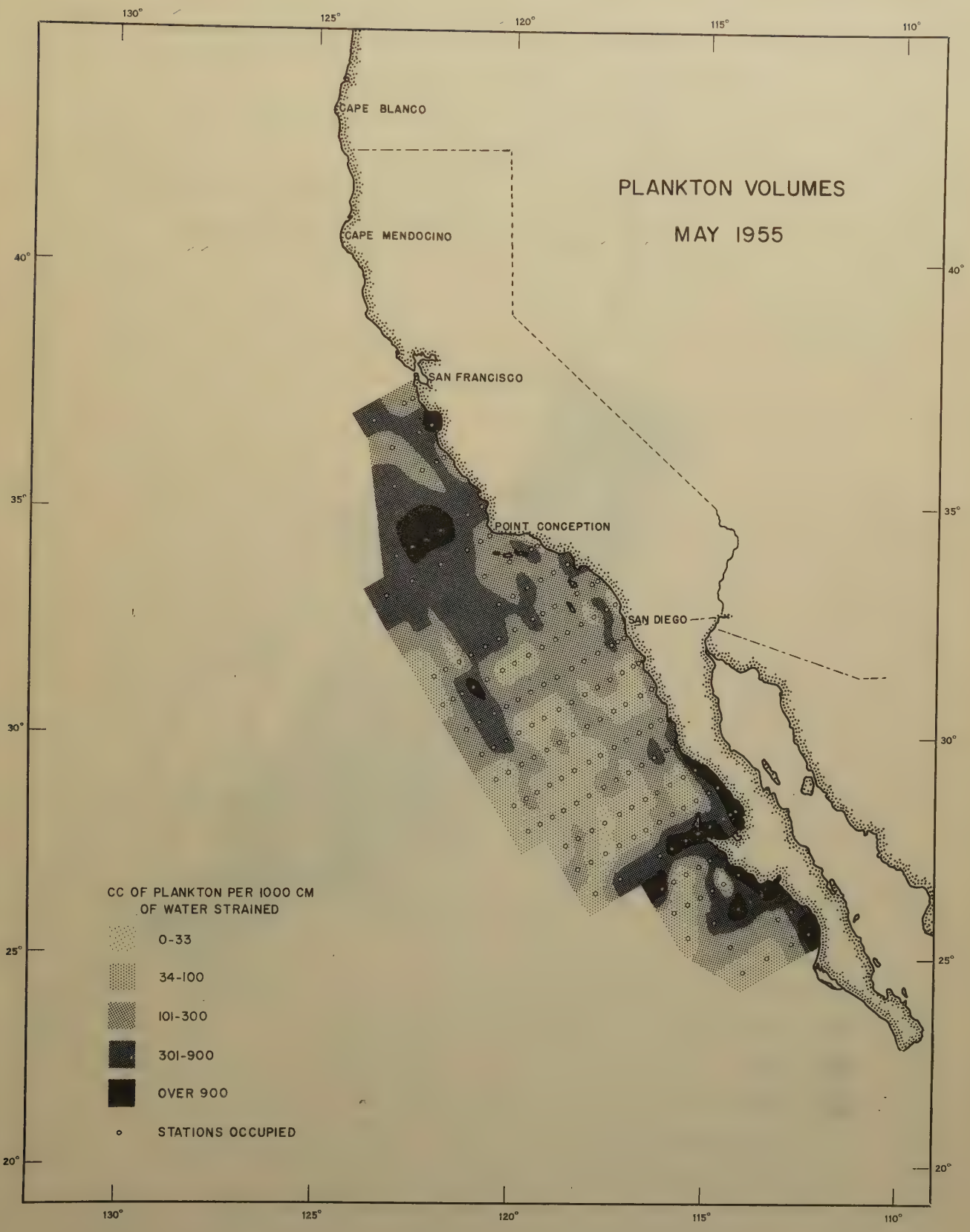
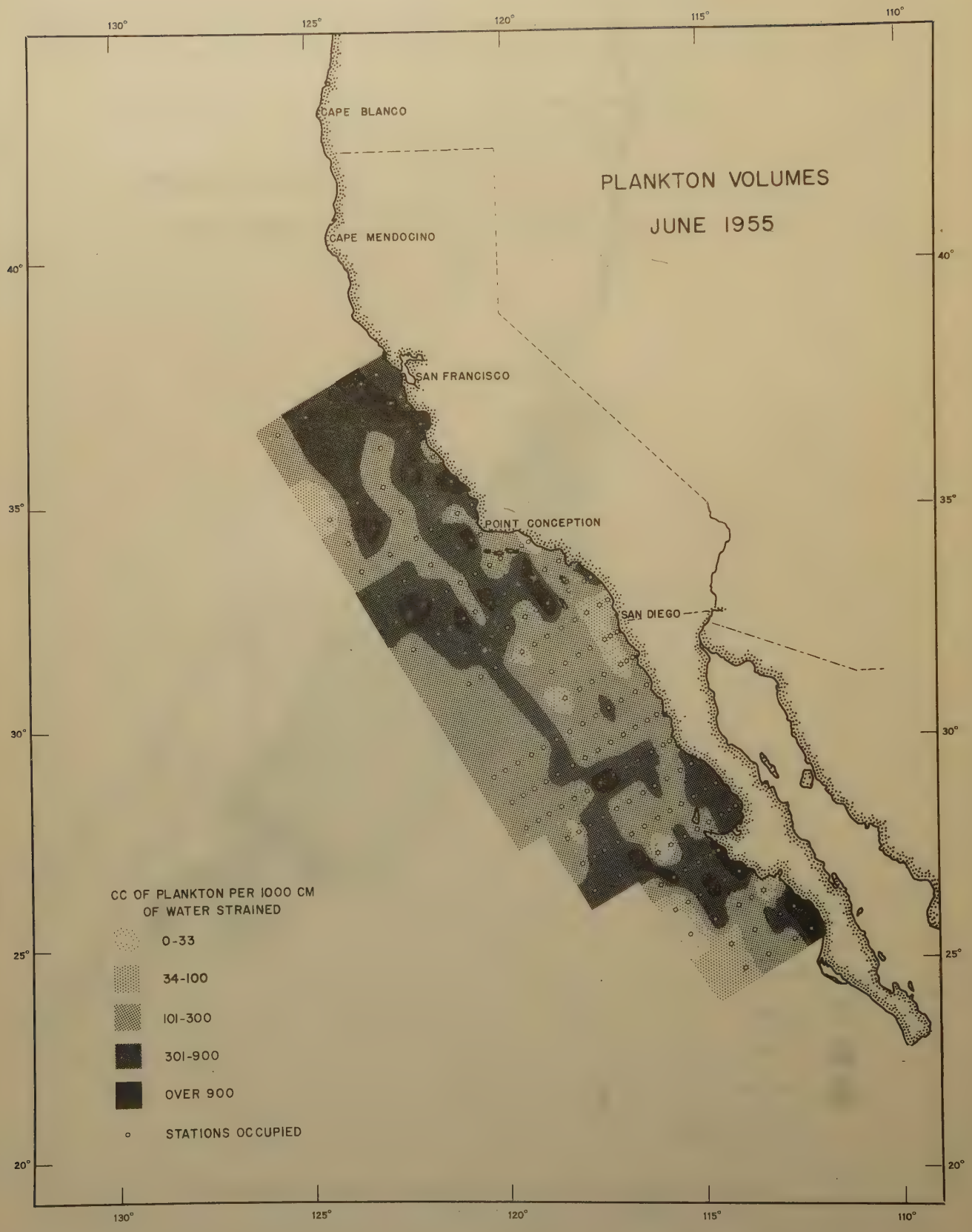
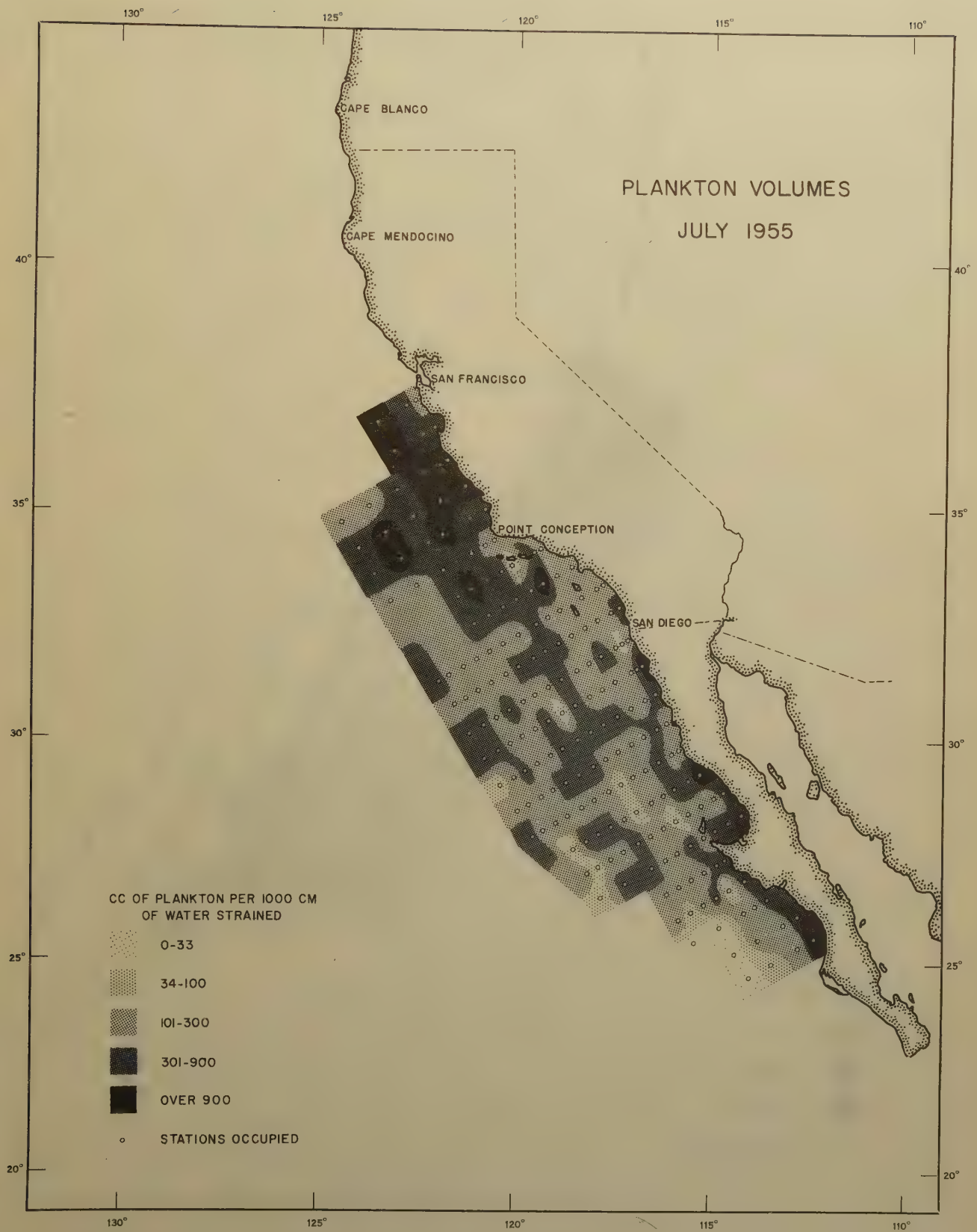
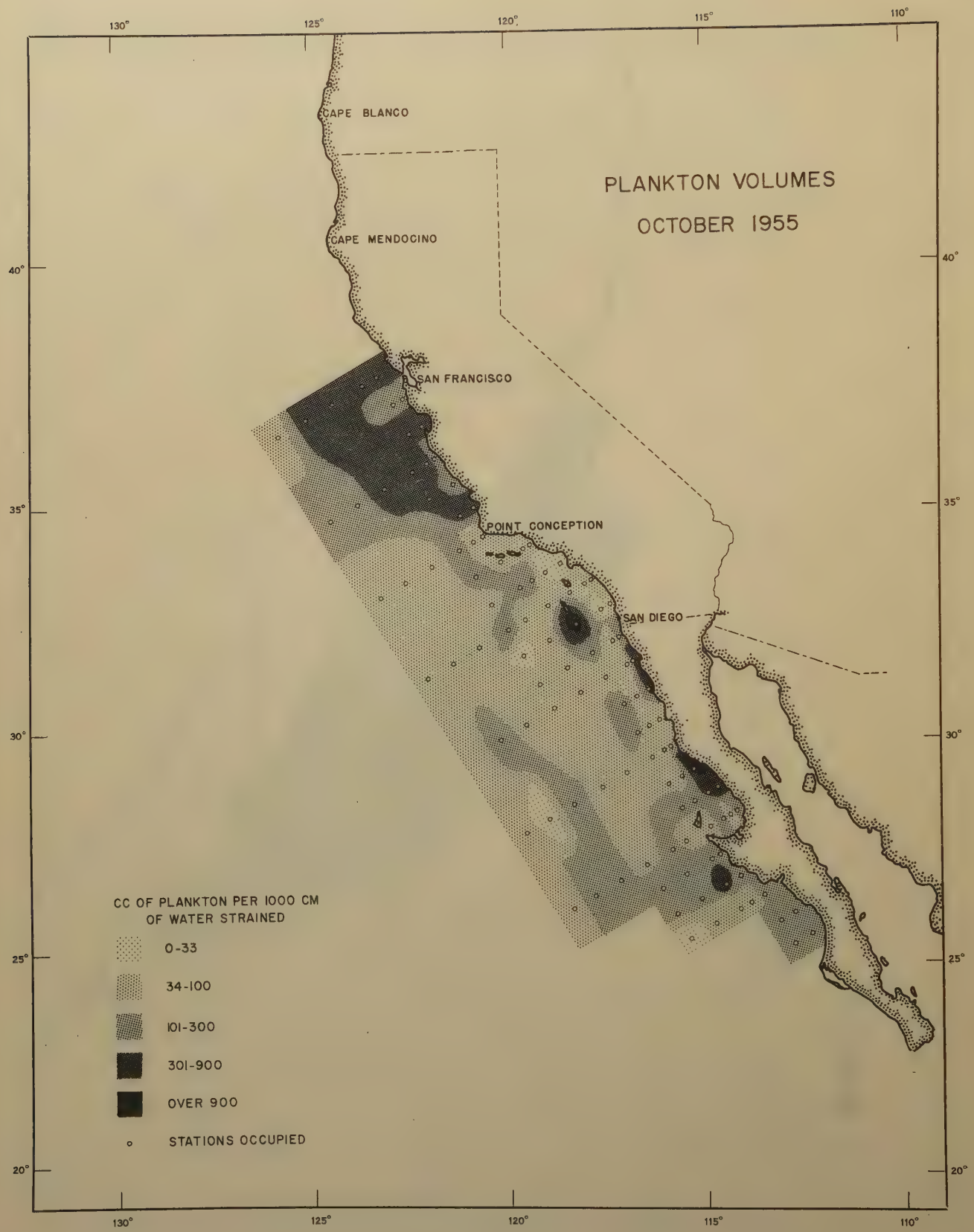
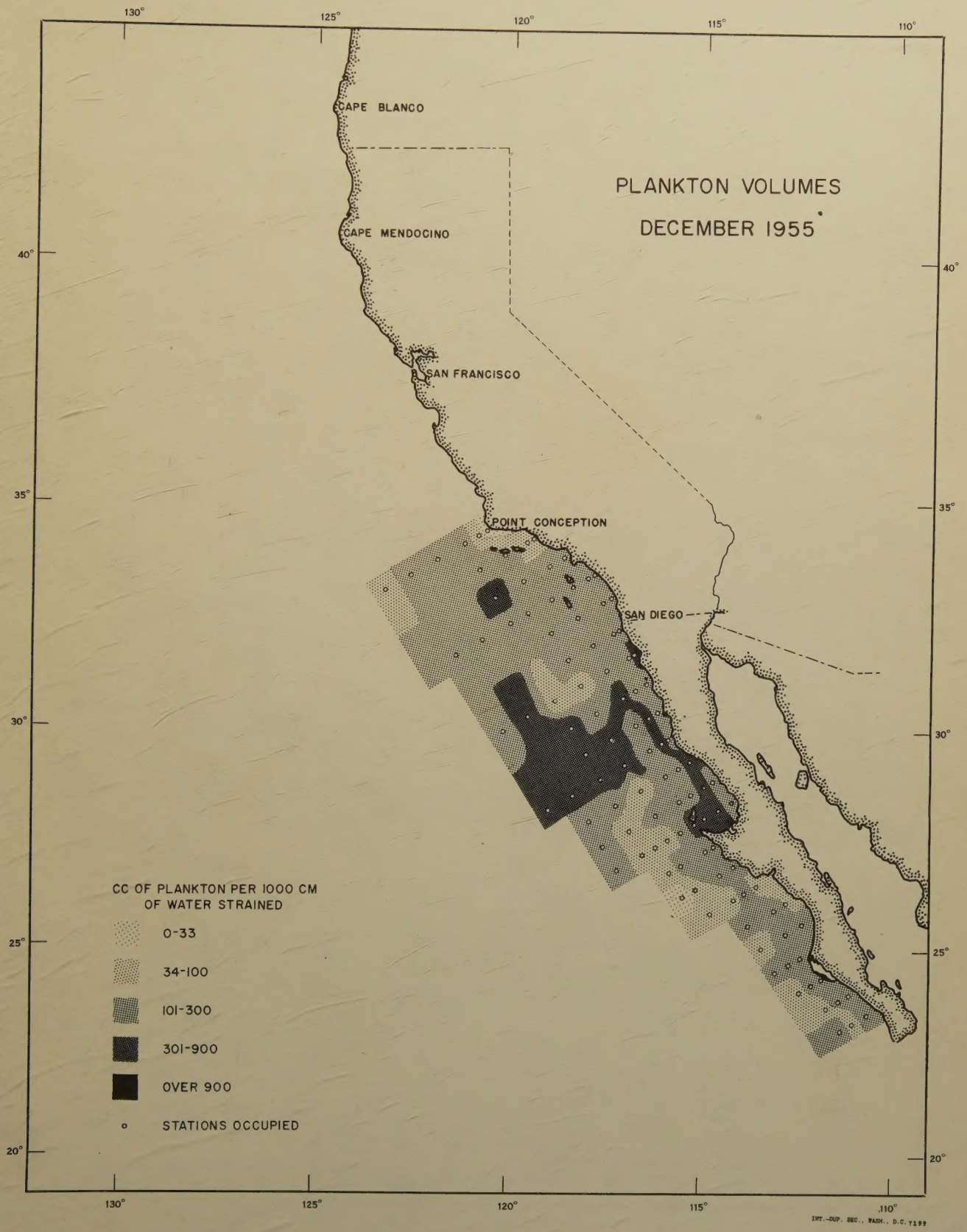
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
MAY 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JUNE 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
JULY 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
OCTOBER 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED


PLANKTON VOLUMES
DECEMBER 1955
CAPE BLANCO
CAPE MENDOCINO
SAN FRANCISCO
POINT CONCEPTION
SAN DIEGO
130°
125°
120°
115°
110°
40°
35°
30°
25°
20°
CC OF PLANKTON PER 1000 CM
OF WATER STRAINED
0-33
34-100
101-300
301-900
OVER 900
STATIONS OCCUPIED
INT.-DUP. SEC., WASH., D.C. 7199